

The
AMSAT[®]
Journal



January/February 2008

180 200 220 240 260 280 300 320 340 360 380 400 420 440 460 480 500 520

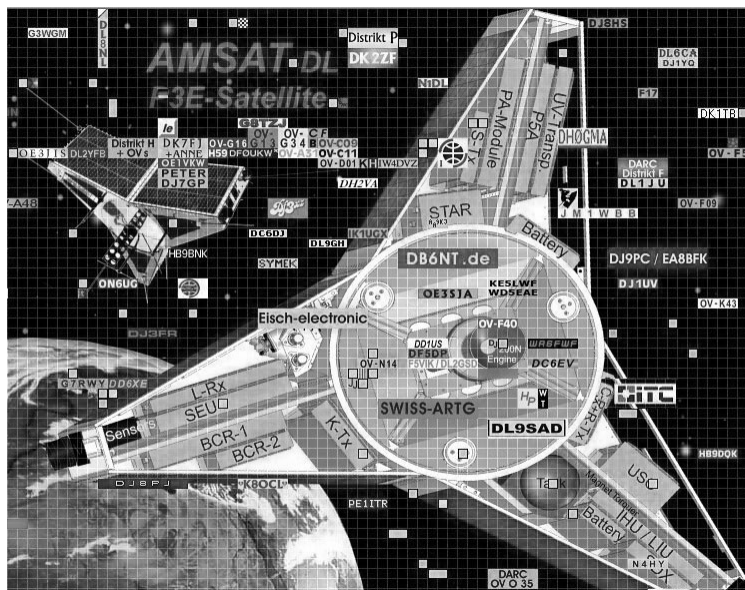
RSSI (Received Signal Strength Indicator) value from SQRX receiver

-- Indicates Satellite Subpoint at Sample Time



Courtesy of KO4MA and KE4AAZ. AMSAT-NA

Global RF Survey Using AO-51



P3E Pixels

Periodicals

POSTAGE PAID

At Silver Spring, MD
and at additional
mailing offices

in this issue

AMSAT Announcements	2
Apogee View	3
<i>by Rick Hambly • W2GPS</i>	
Learn DSP By Programming	4
Your PC, Part 4	4
<i>by Richard Crow • N2SPI</i>	
A Pole Mounted	12
Downconverter for 70 cm	12
<i>by Pete Carr • WW3O</i>	
AMSAT-DC Meeting	14
Announcement	14
<i>by Pat Kilroy • N8PK</i>	
The Orbital Classroom #12	16
Lunar Link Analysis	16
<i>by H. Paul Shuch • N6TX</i>	
AO-16 Reconfigured	19
for Voice Service	19
<i>by Andrew Glasbrenner • KO4MA</i>	
AMSAT Marketing	21
<i>by Dan Briner • AB3EN</i>	
Letters	21
Global RF Surveys with the	22
AO-51 SQRX Tunable Receiver	22
<i>by Andrew Glasbrenner • KO4MA</i>	
News from the ZEL	24
A P3E Update Part II	24
<i>by Gould Smith • WA4SXM</i>	
Experiments with	27
Supercapacitors	27
<i>by John M. Franke • WA4WDL</i>	
Orlando HamCation Photos.....	30
<i>by Ed Long • WA4SWJ</i>	
AMSAT-NA Board of Directors	31
Meeting Minutes Oct 5 & 6, 2006	31
<i>by Barry Baines • WD4ASW</i>	
Orlando HamCation Photos.....	35
<i>by Ed Long • WA4SWJ</i>	

How You Can Help Build New and Exciting Satellites

Donate to the President's Club

Gold, Silver, Bronze and Core levels are available to match your ability to participate.

Cash Gifts

Visa, or MasterCard or checks are accepted. And, you can specify how your contribution is to be used.

Gift of Life Insurance

US taxpayers may be able to receive a significant income tax deduction by making The Radio Amateur Satellite Corporation the owner and beneficiary of life insurance policies.

Gift of Stocks or other Securities

US taxpayers should be able to avoid capital gains taxes on appreciated securities and receive a deduction for their fair market value.

Bequest

A codicil in your will, naming The Radio Amateur Satellite Corporation as a beneficiary will help insure the continuance of the Amateur Radio Satellite program.

Call the AMSAT-NA office at 301-589-6062 for questions on any or all of these ways you can help build new and exciting satellites.

Support AMSAT-NA

AMSAT Announcements

Dates for AMSAT-UK Colloquium

Please be advised that the dates for the next AMSAT-UK Colloquium are 25/26/27 July 2008. Location and general arrangements will be similar to last year's event. More details later. Please note the date in your diaries NOW.

HNY es 73
Jim, G3WGM
Hon Sec AMSAT-UK

AMSAT-DC Meeting Announcement

Meeting to be held March 15th. Please see full announcement on page 14.

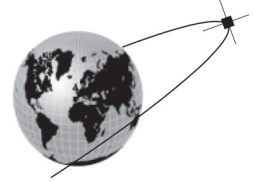
AMSAT's Mission

AMSAT is a non-profit volunteer organization which designs, builds and operates experimental satellites and promotes space education. We work in partnership with government, industry, educational institutions and fellow Amateur Radio societies. We encourage technical and scientific innovation, and promote the training and development of skilled satellite and ground system designers and operators.

AMSAT's Vision

Our Vision is to deploy high earth orbit satellite systems that offer daily coverage by 2009 and continuous coverage by 2012. AMSAT will continue active participation in human space missions and support a stream of LEO satellites developed in cooperation with the educational community and other amateur satellite groups.





Radio Amateur Satellite Corporation (AMSAT-NA)
850 Sligo Ave., Silver Spring, MD 20910-4703
Telephone: 301-589-6062 – Toll Free: 888-322-6728
Facsimile: 301-608-3410

AMSAT-NA Club Callsign: W3ZM
AMSAT-NA Web site: <http://www.amsat.org>

The AMSAT Journal Staff

Editor-in-Chief: Ed Long, WA4SWJ, wa4swj@amsat.org
Assistant Editor: Bill Hook, W3QBC
Circulation: Martha Saragovitz, martha@amsat.org

AMSAT-NA Board of Directors

Barry Baines, WD4ASW, wd4asw@amsat.org
Tom Clark, K3IO, k3io@amsat.org
Drew Glasbrenner, KO4MA, ko4ma@amsat.org
Rick Hambly, W2GPS, w2gps@amsat.org
Lou McFadin, W5DID, w5did@amsat.org
Bob McGwire, N4HY, n4hy@amsat.org
Gunther Meisse, W8GSM, w8gsm@amsat.org

AMSAT-NA Senior Officers

President: Richard Hambly, W2GPS
Executive Vice-President: Lee McLamb, KU4OS
Treasurer: Gunther Meisse, W8GSM
Corporate Secretary & VP Special Projects:
Barry Baines, WD4ASW
Manager: Martha Saragovitz
Vice-President, Engineering: Bob McGwier, N4HY
Vice-President, Operations: Drew Glasbrenner, KO4MA
Vice-President User Services: Gould Smith, WA4SXM
Vice President, Marketing: Dan Briner, AB3BN

Honorary Positions

Immediate Past President: Robin Haighton, VE3FRH
President Emeritus: Tom Clark, K3IO
Founding President: Perry Klein, W3PK

Editorial Office: Ed Long, WA4SWJ, 6685 Southeast 108th Street, Belleview, FL, 34420-3449. Please e-mail Journal submissions to: journal@amsat.org, telephone: 262-374-1349. **Advertising Office:** AMSAT-NA Headquarters, 850 Sligo Avenue, Suite 600, Silver Spring, MD 20910-4703.

The AMSAT Journal (ISSN: 1407-3076) is published bi-monthly (Jan/Feb, Mar/Apr, May/Jun, Jul/Aug, Sep/Oct, Nov/Dec) by AMSAT-NA, 850 Sligo Avenue, Suite 600, Silver Spring, MD 20910-4703. Telephone: 301-589-6062, fax: 301-608-3410. Periodicals postage paid at Silver Spring, MD and additional mailing offices.

Postmaster: Send address changes to *The AMSAT Journal*, 850 Sligo Avenue, Suite 600, Silver Spring, MD 20910-4703.

Opinions expressed in *The AMSAT Journal* are those of the article authors and are not necessarily those of AMSAT-NA. Copyright © 2008 by AMSAT-NA, The Radio Amateur Satellite Corporation. AMSAT is a registered trademark. Reproduction of material from *The AMSAT Journal* by mechanical, electronic, photocopy or other means is prohibited unless written permission is obtained from the author.

The AMSAT Journal staff is always interested in article submissions. Whenever possible, submissions should be sent via e-mail to journal@amsat.org using plain text or word processor files; photos or figures in TIF, GIF or JPEG formats. AMSAT-NA reserves the right to select material for *The AMSAT Journal* based on suitability of content and space considerations. The editors of this publication are volunteers giving freely of their talents, time and efforts to produce *The AMSAT Journal*.

AMSAT's Meetings in Orlando FL

In early February, many AMSAT executives, board members and Eagle design team members arrived in Orlando, Florida for a series of meetings held at the Orlando HamCation and a nearby hotel. This turned out to be a great event and was cost effective because of the low airfares to Orlando and the fact that many of the people attending were scheduled to attend more than one of these meetings. It was made even better due to the great Orlando weather, the thoughtfulness of the sponsors (The Orlando Amateur Radio Club), and an outstanding AMSAT booth manned by the local AMSAT Field Operations team led by the AMSAT area coordinator for Central Florida, David Jordan, AA4KN. AMSAT's presence at the HamCation included a fully operational satellite station with Robert Davies, KI4HXT, conducting many of the satellite demos. The donations collected this year at the booth greatly exceeded past HamCations.

Friday, February 8th we began with a nearly 12 hour meeting at the hotel to discuss various AMSAT Engineering issues including the development of Suitsat-2, Eagle, the Phase-4 payload, the Advanced Communications Package (ACP), AO-51 improvements and the rescue of AO-16. The meeting also covered two projects that AMSAT is assisting the Hawk Institute where our new AMSAT Integration Lab is located in Pocomoke, MD. The first project is a student CubeSat project and the other is HASP: High Altitude Student Payload. Both projects have launch dates this summer. Assisting in these projects helps AMSAT fulfill our education mission as well as provides an opportunity for the AMSAT Integration Lab to be placed into service on active projects. HASP will feature a derivation of the SDX transponder that will fly later on SuitSat-2 and will allow us to test the SDX transponder in a flight environment.

On Saturday we presented a forum at HamCation that was so well attended all seats were taken and there was standing room only. Many of our officers and board members spent time in the AMSAT booth meeting members and old friends.

Sunday morning we returned to the HamCation site where we took over the forum building for an AMSAT Board of Directors meeting. There were no momentous decisions made during this meeting; it was

mostly to inform the board of the state of the organization and our projects and for the executive team to receive strategic guidance from the board.

On Monday a smaller meeting was held at the hotel for our new Eagle / P4 program manager, Barry Baines, WD4ASW, to work with our VP Engineering Bob McGwier, N4HY, to plan activities, schedules and milestones for AMSAT's major projects. Barry is also AMSAT's Corporate Secretary and VP of Special Projects.

John Klingelhoefter, WB4LNM, and I were on the same flight going home. We had many hours to review the weekend's activities and plan new strategies as our plane to Maryland was delayed nearly four hours by "weather". It was so easy to forget the extreme weather engulfing much of the country while spending a glorious weekend in Orlando enjoying warm breezes, blue sky and good friends.

Donations

I would like to thank the many loyal AMSAT members who have sent contributions over the past two months. As you may know I personally sign every "thank you" letter and my writing hand is sore from all the signing I had to do. Your generosity has made me feel optimistic about the future of our organization. I hope the rest of you will take a moment to make a donation. Large or small, all donations are greatly appreciated. It only takes a few seconds to make a donation through the AMSAT on-line store at www.amsat.org or to call Martha at (301) 589-6062. Don't forget to ask about the President's Club. You are eligible for a free dinner at the joint AMSAT-TAPR banquet at Dayton if you join at the Gold level or above.

Summary

I know I said this last time but it bears repeating. AMSAT needs your support including your feedback, your donations and your participation in AMSAT activities. Please become a part of AMSAT's future by donating some of your time to an AMSAT project or activity.

73,
Richard M. Hambly, W2GPS
AMSAT President ☸



Learn DSP By Programming Your PC, Part 4

by Richard F. Crow, N2SPI, n2spi@amsat.org

Copyright 2008 by Richard F. Crow

Introduction

To make DSP really useful you need to be able to input external signals of your choice as well as process signals and output them. So far in this series, you've only been shown how to generate signals internally, filter them and output them. So now this part is going to show you how to write a PC program, which will input external signals and then output them. Such a "pass-through" program may not seem like much, but it is the basic software infrastructure that underlies and supports most all DSP applications. Once you establish a working pass-through program, you simply insert your DSP algorithms between the input samples coming in and the output samples going out. Again, if you have not read the other parts in this series, I strongly encourage you to start with Part 1 in the July/August 2007 issue of *The AMSAT Journal* followed by the other parts in ascending order. Also note that software for this series is now downloadable from the AMSAT Web site. From www.amsat.org, click "START New to Satellites?", scroll down to "More Advanced Topics" and locate "Learn DSP By Programming Your PC".

As in Part 2, this part is all about writing software. So, not surprisingly, the approach here mimics that of Part 2. If you successfully programmed Part 2, you should have no trouble here. The software here is basically that of Part 2 with the code for the sine wave generator stripped-out and the code for inputting signals added in. It is the largest program to date. But once written, it can be used over and over for many DSP experiments. So let's get started.

STEP 1: Make new subdirectories

Right now, boot up your PC, open a

DOS window and navigate to `c:\dm849c\dm\bin`. Then, use the DOS command "md" to make a new subdirectory (folder) named "PassThru". Next, navigate to the PassThru subdirectory and make six more subdirectories named "stage1", "stage2", "stage3", "stage4", "stage5" and "stage6".

STEP 2: Create make4.bat and passthru.rc

Navigate to `c:\dm849c\dm\bin\PassThru\stage1` and type up `make4.bat` as shown in Figure 1. Next, type up `passthru.rc` as shown in Figure 2.

STEP 3: Create passthru.c, stage1

While still in `c:\dm849c\dm\bin\PassThru\stage1`, type up `passthru.c stage1` as shown in Figure 3. Run `make4.bat` and execute `passthru.exe`. If all is OK, you should see a dialog box like the one in Part 2 but with the horizontal scrollbar missing and replaced with the text "Pgm debug: Stage1". This text results from the temporary C statement immediately following line 044. The comments that apply to Part 2 stage1 essentially apply here also. The only real difference is that the function `DigitalSignalProcessing()` has been piggybacked to this stage as this is as good a time as any to type it in.

STEP 4: Update passthru.c, stage2

Copy `make4.bat`, `passthru.rc`, and `passthru.c` from `c:\dm849c\dm\bin\PassThru\stage1` to `c:\dm849c\dm\bin\PassThru\stage2`. Delete everything between lines 044 and 315. Now type in the code starting with line 045 and ending with line 072 as shown in Figure 4. In addition, type in the code starting with line 279 and ending with line 314 also shown in Figure 4. Now you should see the same dialog box as in stage1 except with the text

"Pgm debug: Stage2". This text does not result from anything in `passthru.c`, but rather from from line 022 in `passthru.rc`. Again, the comments that apply to Part 2 stage2 basically apply here too.

STEP 5: Update passthru.c, stage3

Copy `make4.bat`, `passthru.rc`, and `passthru.c` from stage2 to stage3. Type in the code starting with line 073 and ending with line 117 shown in Figure 5. Now the dialog box should display, "Pgm debug: Stage3" as a result of the statement in line 116. This stage adds code to begin the lengthy initialization that starts with "case WM_INITDIALOG:".

STEP 6: Update passthru.c, stage4

By now you should know the drill. Copy the usual files from stage3 to stage4. Type in the code starting with line 118 and ending with line 169 shown in Figure 6. The dialog box now displays "Pgm debug: Stage4" as a result of line 168. This stage adds more code to the initialization.

STEP 7: Update passthru.c, stage5

Copy files from stage4 to stage5. Type in the code starting with line 170 and ending with line 222 shown in Figure 7. The dialog box now displays "Pgm debug: Stage5". This stage completes the initialization.

STEP 8: Finish passthru.c, stage6

Copy files from stage5 to stage6. Type in the code starting with line 223 and ending with line 278 shown in Figure 8 and run `make4.bat`. If not connected already, connect a suitable microphone to the microphone input of your sound card. In addition, make sure the PC's speakers are connected and operational. Now, run `passthru.exe` and talk into the microphone. If everything is working, you'll hear the sound you make

```
REM Filename:      make4.bat, version 1.0
REM Description:   Compiles .res resource file from .rc resource script.
REM              Then, compiles .c source file and links it using the specified options
REM Programmer:    Richard F. Crow, N2SPI, January 21, 2008
echo on
cls
C:\dm849c\dm\bin\rcc passthru.rc -32
C:\dm849c\dm\bin\dmc passthru.c winmm.lib comctl32.lib -mn -WA -L/RC -L/SUBSYSTEM:WINDOWS:4.0
pause
```

Figure 1




```
//001) Filename:      passthru.rc, version 1.0
//002) Description:  Resource script to make passthru.res resource
//003)                file that goes with passthru.c, a Windows XP pgm
//004)                that inputs signal samples and then outputs them
//005) Programmer:   Richard F. Crow, N2SPI, January 21, 2008
//006) (this line reserved)
#define IDC_TEXT1 1000 //007) (must match same #define in passthru.c)
//008) (this line reserved)
//009) (this line reserved)
#include<windows.h> //010) (preproces'r inserts text in".h"files..
//011) ...so pgm gets needed'C'definitions)

passthru_resources DIALOG DISCARDABLE 100, 100, 200, 50

STYLE WS_MINIMIZEBOX | WS_VISIBLE | WS_CAPTION | WS_SYSMENU

CAPTION TEXT("PasThru, v1.0: Inputs signal samples, then outputs them")

FONT 8, TEXT("Courier")

BEGIN
    CTEXT TEXT("Pgm debug: Stage2"), IDC_TEXT1, 58, 4, 80, 8
END
```

Figure 2

come out the speakers, albeit delayed by 1/3 of a second or so.

If this doesn't happen, verify the operation of the speakers by running d2a.exe from Part 2 and configure the Volume Control program for sound card output, if necessary, as discussed at the end of Part 2. To get the sound card input working, click Start > All Programs > Accessories > Entertainment > Volume Control. Then, click Options > Properties, select Recording, check Microphone, and click OK. Next, check the microphone Select box, drag the microphone volume control to max and verify the balance control is centered. For more microphone gain, click the Advanced button and check MIC Boost if you have this option. To verify the microphone itself is working, click Start > All Programs > Accessories > Entertainment > Sound Recorder, record something, and play it back.

As for an explanation of passthru.c, first note there are 4 Inbuffers filled in round-robin fashion and 4 OutBuffers emptied in round-robin fashion. In "case MM_WIM_OPEN:", the four InBuffers are queued up but the inputting process is not started. By comparison, the outputting process starts after the four OutBuffers are queued up in "case MM_WOM_OPEN:". After OutBuffer1 and OutBuffer2 have been emptied for the first time, "case MM_WOM_DONE:" starts

the inputting of signal samples so as to synchronize inputting with outputting. Now, InBuffer1 will be filled while OutBuffer3 is being emptied, InBuffer2 while OutBuffer4, InBuffer3 while OutBuffer1, InBuffer4 while OutBuffer2, InBuffer1 while OutBuffer3, and so forth. When an InBuffer becomes full, "case MM_WIM_DATA:" identifies which InBuffer is full and then processes it with DigitalSignalProcessing() which it turn deposits its results in the corresponding OutBuffer. As a consequence of all this, when it's OutBuffer1's turn to step up to the plate, it will have been in the queue for some time, and OutBuffer2 will be on its way to the queue, to give an example focusing only on the outputting of OutBuffer1. Stacking up buffers like this adds elasticity to the program so when Window's pre-emptive multitasking systematically suspends the processing going on in passthru.exe, it doesn't result in a signal dropout in either the inputting or outputting of samples.

To do this necessitates the 4 InBuffers, the 4 OutBuffers, and all the associated overhead, which is the principal reason passthru.c is so large and complicated. Also, the two buffer offset between input and corresponding output samples contributes the annoying 1/3 second delay. (Reduce BUFFER_SIZE on line 013 by as much as you can to minimize this.) By comparison, a real DSP processor, like the one in the DSPx mentioned in Part

1, can dedicate itself full-time to the DSP task at hand resulting in virtually zero delay between input and output. In addition, the pass-through program for such a processor is much simpler and its appetite for memory resources is relatively minuscule. So, among other reasons, the consequences of Windows being a pre-emptive multitasking operating system make it unattractive for DSP applications, at least in my view.

And finally ...

The introduction mentioned that once a working pass-through program is established, you can insert your DSP algorithm between the input and output samples. So try this. Replace DigitalSignalProcessing() in passthru.c with the 3 kHz lowpass filter software in Part 3 using the instructions there as a guide. Now you can input audio signals from your microphone, radio, or CD Player, etc., and hear what the 3 kHz filter does to them. If you want a different filter, use ScopeFIR to generate a new kernel.

And finally, since this is the Journal of the RADIO Amateur Satellite Corporation, it might be nice to discuss some RADIO related DSP programs. So next time, DigitalSignalProcessing() will be rewritten to transform it into a fundamental SDR

text concludes on page 8 ...



```

//001) Filename:      passthru.c, version 1.0
//002) Description:   A DSP program for Windows XP that acquires input
//003)                samples and then outputs them.
//004) Programmer:    Richard F. Crow, N2SPI, January 21, 2008

                                //006) (this line reserved)
#define IDC_TEXT1 1000         //007) (MustMatchSame #define, passthru.rc)
                                //008) (this line reserved)
                                //009) (this line reserved)
#include<windows.h>           //010) (preprocr inserts text in".h"files..
#include<math.h>              //011) ...so pgm gets needed'C'definitions)
#define SAMPLE_RATE 44100     //012) (i.e. 22.7 us between samples)
#define BUFFER_SIZE 8192      //013) (size in bytes is 2*BUFFER_SIZE )

TCHAR szTemplateName[] = TEXT( "passthru_resources" );
TCHAR szErrorMsg1[]     = TEXT( "WaveIn  memory allocation failed!");
TCHAR szErrorMsg2[]     = TEXT( "WaveOut memory allocation failed!");
TCHAR szErrorMsg3[]     = TEXT( "Opening WaveIn  device failed!" );
TCHAR szErrorMsg4[]     = TEXT( "Opening WaveOut device failed!" );

BOOL CALLBACK DlgProc(HWND, UINT, WPARAM, LPARAM); //func prototypes
void DigitalSignalProcessing( PSHORT, PSHORT );
//===== Line 023 =====
int WINAPI WinMain(                                //024)WinMain() starts this app:
    HINSTANCE hInstance,                          //025)=a number that identifies..
    HINSTANCE hPrevInstance,                      //026).this occurrence of this app
    PSTR szCmdLine,                               //027)=ptr @ cmd line text,if any
    int iCmdShow )                               //028)=init'l window(maxmzd?,etc)
{
    DialogBox(                                    //030)create a Dialog Box:
        hInstance,                               //031)="instance"handl 4 this pgm
        szTemplateName,                         //032)=ptr @ Dialog Box resources
        NULL,                                   //033)=handl of ownr window(none)
        DlgProc );                             //034)=ptr @ Dialog Box procedure
    return 0;
}
//===== Line 037 =====
//036) ( end of "WinMain()" )
BOOL CALLBACK DlgProc(                            //038)DlgProc handles WinOS msgs:
    HWND hwnd,                                   //039)=handl of window get'g msgs
    UINT message,                               //040)=number that is the message
    WPARAM wParam,                              //041)=1st numbr with msg details
    LPARAM lParam )                             //042)=2nd numbr with msg details
{
    //044)===== Line 044=====

    SetDlgItemText(hwnd, IDC_TEXT1, TEXT("Pgm debug: Stage1")); //tmp

    if( (message == WM_SYSCOMMAND) && (wParam == SC_CLOSE) ) //(temp)
        EndDialog( hwnd, 0 );                               //(temp)

    /*** NOTE: other lines between 044 and 315 will be typed in later

                                //315)===== Line 315 =====
    return FALSE;                                              //316)IfGetHere, msg not handled
}                                                            //317) ( end of "DlgProc()" )
//===== Line 318 =====
void DigitalSignalProcessing( PSHORT pIn, PSHORT pOut )
{
    int i;                                                    //321) (note: AtThisTime,this is..
                                                            //322)..a dummy "pass-thru" func)

    for(i=0 ; i<BUFFER_SIZE ; i++)
        pOut[i] = pIn[i];                                     //324)copy "InBuf" to "OutBuf"
}                                                            //325) (end of "DigitalSig...()" )
//===== Line 326 =====
// end of program

```

Figure 3

```

//044)===== Line 044 =====
static BOOL      bAtStartOfPgm; //045)=flag,signals"ProgramStart"
static WAVEFORMATEX waveformat; //046)=a WavFormat data structure
MMRESULT        mmResult;      //047)=numbr(return from mm_func)
PSHORT          pBufThatIsFull; //048)=temporary pointer

static PWAVEHDR  pWavInHdr1;    //050)=pointer to (address of)...
static PWAVEHDR  pWavInHdr2;    //051)...a WaveInHeader structure
static PWAVEHDR  pWavInHdr3;    //052)=pointer@3rd WavInHdr struct
static PWAVEHDR  pWavInHdr4;    //053)=ptr to 4th WavInHdr struct
static PSHORT    pInBuffer1;    //054)=ptr to 1st WaveIn buffer
static PSHORT    pInBuffer2;    //055)=ptr to 2nd WaveIn buffer
static PSHORT    pInBuffer3;    //056)=ptr to 3rd WaveIn buffer
static PSHORT    pInBuffer4;    //057)=ptr to 4th WaveIn buffer
static HWAVEIN   hWaveIn;       //058)=handle(ID #,WaveIn device)

static PWAVEHDR  pWavOutHdr1;    //060)=ptr to WaveOutHdr1 struct
static PWAVEHDR  pWavOutHdr2;    //061)=ptr to WaveOutHdr2 struct
static PWAVEHDR  pWavOutHdr3;    //062)=ptr to WaveOutHdr3 struct
static PWAVEHDR  pWavOutHdr4;    //063)=ptr to WaveOutHdr4 struct
static PSHORT    pOutBuffer1;    //064)=ptr @ 1st WaveOut buffer
static PSHORT    pOutBuffer2;    //065)=ptr @ 2nd WaveOut buffer
static PSHORT    pOutBuffer3;    //066)=ptr @ 3rd WaveOut buffer
static PSHORT    pOutBuffer4;    //067)=ptr @ 4th WaveOut buffer
static HWAVEOUT  hWaveOut;       //068)=handl(ID# for WaveOut dev)

switch(message) //070) (IfMatchBetween"message"...
{ //071)..& "case...",execute case)
//072)===== Line 072 =====

// *** NOTE: lines between 072 and 279 will be typed in later ***

//279)===== Line 279 =====
case WM_SYSCOMMAND: //280)msg when WinOS system event
    if( wParam == SC_CLOSE ) //281)if get sub-message that...
    { //282)...dialog is closing, then
        waveInReset( hWaveIn ); //283)stop WaveIn device
        waveInClose( hWaveIn );
        waveInUnprepareHeader(hWaveIn, pWavInHdr1, sizeof(WAVEHDR));
        waveInUnprepareHeader(hWaveIn, pWavInHdr2, sizeof(WAVEHDR));
        waveInUnprepareHeader(hWaveIn, pWavInHdr3, sizeof(WAVEHDR));
        waveInUnprepareHeader(hWaveIn, pWavInHdr4, sizeof(WAVEHDR));
        free( pWavInHdr1 );
        free( pWavInHdr2 ); //290)release allocated memory
        free( pWavInHdr3 ); //291)release allocated memory
        free( pWavInHdr4 ); //292)release allocated memory
        free( pInBuffer1 ); //293)release allocated memory
        free( pInBuffer2 ); //294)release allocated memory
        free( pInBuffer3 ); //295)release allocated memory
        free( pInBuffer4 ); //296)release allocated memory
        waveOutReset( hWaveOut ); //297)stop WaveOut device
        waveOutClose( hWaveOut );
        waveOutUnprepareHeader(hWaveOut, pWavOutHdr1, sizeof(WAVEHDR));
        waveOutUnprepareHeader(hWaveOut, pWavOutHdr2, sizeof(WAVEHDR));
        waveOutUnprepareHeader(hWaveOut, pWavOutHdr3, sizeof(WAVEHDR));
        waveOutUnprepareHeader(hWaveOut, pWavOutHdr4, sizeof(WAVEHDR));
        free( pWavOutHdr1 );
        free( pWavOutHdr2 ); //304)release allocated memory
        free( pWavOutHdr3 ); //305)release allocated memory
        free( pWavOutHdr4 ); //306)release allocated memory
        free( pOutBuffer1 ); //307)release allocated memory
        free( pOutBuffer2 ); //308)release allocated memory
        free( pOutBuffer3 ); //309)release allocated memory
        free( pOutBuffer4 );
        EndDialog( hwnd, 0 ); //311)end dialog & return from...
        return TRUE; //312)..this iteration of DlgProc
    }

} //314) (end of"switch(message){}")
//315)===== Line 315 =====

```

Figure 4




```

//072)===== Line 072 =====
case WM_INITDIALOG: //073)msg when dialog box created
    bAtStartOfPgm = TRUE; //074)SoCodeElsewherCanDetectThis

    pWavInHdr1 = (PWAVERHDR)malloc( sizeof(WAVEHDR) );
    pWavInHdr2 = (PWAVERHDR)malloc( sizeof(WAVEHDR) ); //allocate..
    pWavInHdr3 = (PWAVERHDR)malloc( sizeof(WAVEHDR) ); //..WaveIn..
    pWavInHdr4 = (PWAVERHDR)malloc( sizeof(WAVEHDR) ); // ...memory
    pInBuffer1 = (PSHORT)malloc( 2 * BUFFER_SIZE );
    pInBuffer2 = (PSHORT)malloc( 2 * BUFFER_SIZE ); // (note:size
    pInBuffer3 = (PSHORT)malloc( 2 * BUFFER_SIZE ); // in bytes)
    pInBuffer4 = (PSHORT)malloc( 2 * BUFFER_SIZE );

    if(!pWavInHdr1 | !pWavInHdr2 | !pWavInHdr3 | !pWavInHdr4
        | !pInBuffer1 | !pInBuffer2 | !pInBuffer3 | !pInBuffer4)
    {
        MessageBox( NULL, szErrorMsg1, NULL, MB_OK ); //IfErrors..
        return FALSE;
    } //090)

    pWavOutHdr1 = (PWAVERHDR)malloc( sizeof(WAVEHDR) );
    pWavOutHdr2 = (PWAVERHDR)malloc( sizeof(WAVEHDR) ); //allocate..
    pWavOutHdr3 = (PWAVERHDR)malloc( sizeof(WAVEHDR) ); //..WavOut..
    pWavOutHdr4 = (PWAVERHDR)malloc( sizeof(WAVEHDR) ); // ...memory
    pOutBuffer1 = (PSHORT)malloc( 2 * BUFFER_SIZE );
    pOutBuffer2 = (PSHORT)malloc( 2 * BUFFER_SIZE ); // (note:size
    pOutBuffer3 = (PSHORT)malloc( 2 * BUFFER_SIZE ); // in bytes)
    pOutBuffer4 = (PSHORT)malloc( 2 * BUFFER_SIZE );

    if(!pWavOutHdr1 | !pWavOutHdr2 | !pWavOutHdr3 | !pWavOutHdr4
        | !pOutBuffer1 | !pOutBuffer2 | !pOutBuffer3 | !pOutBuffer4)
    {
        MessageBox( NULL, szErrorMsg2, NULL, MB_OK ); //IfErrors..
        return FALSE;
    } //106)

    waveform.wFormatTag = WAVE_FORMAT_PCM;
    waveform.nChannels = 1; //set WaveAudio..
    waveform.nSamplesPerSec = SAMPLE_RATE; //...preferences
    waveform.nAvgBytesPerSec = SAMPLE_RATE;
    waveform.nBlockAlign = 2;
    waveform.wBitsPerSample = 16;
    waveform.cbSize = 0;

    SetDlgItemText(hwnd, IDC_TEXT1, TEXT("Pgm debug: Stage3"));
    //117)===== Line 117 =====

    // *** NOTE: lines between 117 and 279 will be typed in later ***

    //279)===== Line 279 =====

```

Figure 5

(Software Defined Radio) building block, a SSB/CW demodulator. Specifically, the next part will present the software to implement a rudimentary 11.025 kHz product detector. You'll be amazed at how easy it is to do this. Then if you have, say, a simple 40m to 11 kHz receive converter, you could use your PC to listen to 40m right away. This will be discussed too.

References

- [1] Petzold, Charles (2000), *Code*, Microsoft Press, Redmond, WA, ISBN 0-7356-0505-X, ISBN 0-7356-1131-9 (paperback)
- [2] Zhang, Tony, and Southmayd, John (2000), *Sams Teach Yourself C In 24 Hours*, Sams Publishing, Indianapolis, IN, ISBN 0-672-31861-X
- [3] Petzold, Charles (1999), *Programming Windows, Fifth Edition*, Microsoft Press, Redmond, WA, ISBN 1-57231-995-X
- [4] Smith, Steven W. (1997), *The Scientist and Engineer's Guide To Digital Signal Processing*, California Technical Publishing, P.O. Box 502407, San Diego, CA 92150-2407, "www.DSPguide.com", ISBN 0-9660176-3-3



```

//117)===== Line 117 =====

mmResult = waveInOpen( &hWaveIn, WAVE_MAPPER, &waveformat,
                      (DWORD)hwnd, 0, CALLBACK_WINDOW );

if(mmResult != MMSYSERR_NOERROR)    //if find errors...
{
    MessageBox( NULL, szErrorMsg3, NULL, MB_OK );
    return FALSE;
}

pWavInHdr1->lpData                = (PSTR)pInBuffer1;
pWavInHdr1->dwBufferLength        = ( 2 * BUFFER_SIZE );
pWavInHdr1->dwBytesRecorded       = 0;
pWavInHdr1->dwUser                = 0; //setup "WaveInHdr1" to...
pWavInHdr1->dwFlags               = 0; // ... "describe" InBuffer1
pWavInHdr1->dwLoops               = 1;
pWavInHdr1->lpNext                = NULL;
pWavInHdr1->reserved              = 0;
waveInPrepareHeader( hWaveIn, pWavInHdr1, sizeof(WAVEHDR) );

pWavInHdr2->lpData                = (PSTR)pInBuffer2;
pWavInHdr2->dwBufferLength        = ( 2 * BUFFER_SIZE );
pWavInHdr2->dwBytesRecorded       = 0;
pWavInHdr2->dwUser                = 0; //setup "WavInHdr2" to...
pWavInHdr2->dwFlags               = 0; // ... "describe" InBuffer2
pWavInHdr2->dwLoops               = 1;
pWavInHdr2->lpNext                = NULL;
pWavInHdr2->reserved              = 0;
waveInPrepareHeader( hWaveIn, pWavInHdr2, sizeof(WAVEHDR) );

pWavInHdr3->lpData                = (PSTR)pInBuffer3;
pWavInHdr3->dwBufferLength        = ( 2 * BUFFER_SIZE );
pWavInHdr3->dwBytesRecorded       = 0;
pWavInHdr3->dwUser                = 0; //setup "WavInHdr3" to...
pWavInHdr3->dwFlags               = 0; // ... "describe" InBuffer3
pWavInHdr3->dwLoops               = 1;
pWavInHdr3->lpNext                = NULL;
pWavInHdr3->reserved              = 0;
waveInPrepareHeader( hWaveIn, pWavInHdr3, sizeof(WAVEHDR) );

pWavInHdr4->lpData                = (PSTR)pInBuffer4;
pWavInHdr4->dwBufferLength        = ( 2 * BUFFER_SIZE );
pWavInHdr4->dwBytesRecorded       = 0;
pWavInHdr4->dwUser                = 0; //setup "WavInHdr4" to...
pWavInHdr4->dwFlags               = 0; // ... "describe" InBuffer4
pWavInHdr4->dwLoops               = 1;
pWavInHdr4->lpNext                = NULL;
pWavInHdr4->reserved              = 0;
waveInPrepareHeader( hWaveIn, pWavInHdr4, sizeof(WAVEHDR) );

SetDlgItemText( hwnd, IDC_TEXT1, TEXT("Pgm debug: Stage4"));
//169)===== Line 169 =====

// *** NOTE: lines between 169 and 279 will be typed in later ***

//279)===== Line 279 =====

```

Figure 6



```

//169)===== Line 169 =====

mmResult = waveOutOpen( &hWaveOut, WAVE_MAPPER, &waveformat,
                        (DWORD)hwnd, 0, CALLBACK_WINDOW );

if(mmResult != MMSYSERR_NOERROR)
{
    //if find errors..
    MessageBox( NULL, szErrorMsg4, NULL, MB_OK );
    return FALSE;
}

pWavOutHdr1->lpData      = (PSTR)pOutBuffer1;
pWavOutHdr1->dwBufferLength = ( 2 * BUFFER_SIZE );
pWavOutHdr1->dwBytesRecorded = 0;
pWavOutHdr1->dwUser       = 0; // setup "WaveOutHdr1" to..
pWavOutHdr1->dwFlags      = 0; // ...describe "OutBuffer1"
pWavOutHdr1->dwLoops      = 1;
pWavOutHdr1->lpNext       = NULL;
pWavOutHdr1->reserved     = 0;
waveOutPrepareHeader(hWaveOut, pWavOutHdr1, sizeof(WAVEHDR) );

pWavOutHdr2->lpData      = (PSTR)pOutBuffer2;
pWavOutHdr2->dwBufferLength = ( 2 * BUFFER_SIZE );
pWavOutHdr2->dwBytesRecorded = 0;
pWavOutHdr2->dwUser       = 0; // setup "WaveOutHdr2" to..
pWavOutHdr2->dwFlags      = 0; // ...describe "OutBuffer2"
pWavOutHdr2->dwLoops      = 1;
pWavOutHdr2->lpNext       = NULL;
pWavOutHdr2->reserved     = 0;
waveOutPrepareHeader(hWaveOut, pWavOutHdr2, sizeof(WAVEHDR) );

pWavOutHdr3->lpData      = (PSTR)pOutBuffer3;
pWavOutHdr3->dwBufferLength = ( 2 * BUFFER_SIZE );
pWavOutHdr3->dwBytesRecorded = 0;
pWavOutHdr3->dwUser       = 0; // setup "WaveOutHdr3" to..
pWavOutHdr3->dwFlags      = 0; // ...describe "OutBuffer3"
pWavOutHdr3->dwLoops      = 1;
pWavOutHdr3->lpNext       = NULL;
pWavOutHdr3->reserved     = 0;
waveOutPrepareHeader(hWaveOut, pWavOutHdr3, sizeof(WAVEHDR) );

pWavOutHdr4->lpData      = (PSTR)pOutBuffer4;
pWavOutHdr4->dwBufferLength = ( 2 * BUFFER_SIZE );
pWavOutHdr4->dwBytesRecorded = 0;
pWavOutHdr4->dwUser       = 0; // setup "WaveOutHdr4" to..
pWavOutHdr4->dwFlags      = 0; // ...describe "OutBuffer4"
pWavOutHdr4->dwLoops      = 1;
pWavOutHdr4->lpNext       = NULL;
pWavOutHdr4->reserved     = 0;
waveOutPrepareHeader(hWaveOut, pWavOutHdr4, sizeof(WAVEHDR) );

SetDlgItemText(hwnd, IDC_TEXT1, TEXT("Pgm debug: Stage5"));
return FALSE;

//222)===== Line 222 =====
// *** NOTE: lines between 222 and 279 will be typed in later ***

//279)===== Line 279 =====

```

Figure 7


```

//222)===== Line 222 =====
case MM_WIM_OPEN:
//223)msg when WaveIn dev opened
    waveInAddBuffer( hWaveIn, pWavInHdr1, sizeof(WAVEHDR) );
    waveInAddBuffer( hWaveIn, pWavInHdr2, sizeof(WAVEHDR) );
    waveInAddBuffer( hWaveIn, pWavInHdr3, sizeof(WAVEHDR) );
    waveInAddBuffer( hWaveIn, pWavInHdr4, sizeof(WAVEHDR) );
    return TRUE;

//229)===== Line 229 =====
case MM_WOM_OPEN:
//230)msg when WaveOut dev opened
    waveOutWrite( hWaveOut, pWavOutHdr1, sizeof(WAVEHDR) ); //(Note
    waveOutWrite( hWaveOut, pWavOutHdr2, sizeof(WAVEHDR) ); //bufs
    waveOutWrite( hWaveOut, pWavOutHdr3, sizeof(WAVEHDR) ); //not
    waveOutWrite( hWaveOut, pWavOutHdr4, sizeof(WAVEHDR) ); //initd
    return TRUE; //)

//236)===== Line 236 =====
case MM_WOM_DONE:
//237)msg when an "OutBuf" is empty
    if( bAtStartOfPgm == TRUE ) //238)if "at start of program"&...
    {
        if((PSHORT)((PWAVEHDR)lParam)->lpData == pOutBuffer2)
        {
            //241).."OutBufs 1&2" now emptied
            waveInStart(hWaveIn); //242)start fill "WaveIn" buf(s)...
            bAtStartOfPgm = FALSE; //243)..  
to sync WaveIn w/ WaveOut
        }
    }
    return TRUE;

//247)===== Line 247 =====
case MM_WIM_DATA:
//248)msg when an "InBuff" is full
    pBufThatIsFull = (PSHORT)((PWAVEHDR)lParam)->lpData;
    if(pBufThatIsFull == pInBuffer1) //if "InBuf1" now full..
    {
        DigitalSignalProcessing( pInBuffer1, pOutBuffer1 );
        waveOutWrite( hWaveOut, pWavOutHdr1, sizeof(WAVEHDR) );
        waveInAddBuffer( hWaveIn, pWavInHdr1, sizeof(WAVEHDR) );
        SetDlgItemText(hwnd, IDC_TEXT1, TEXT("InBuf1---processed"));
    }
    else if(pBufThatIsFull == pInBuffer2) //if "InBuf2" now full..
    {
        DigitalSignalProcessing( pInBuffer2, pOutBuffer2 );
        waveOutWrite( hWaveOut, pWavOutHdr2, sizeof(WAVEHDR) );
        waveInAddBuffer( hWaveIn, pWavInHdr2, sizeof(WAVEHDR) );
        SetDlgItemText(hwnd, IDC_TEXT1, TEXT("InBuf-2--processed"));
    }
    else if(pBufThatIsFull == pInBuffer3) //if "InBuf3" now full..
    {
        DigitalSignalProcessing( pInBuffer3, pOutBuffer3 );
        waveOutWrite( hWaveOut, pWavOutHdr3, sizeof(WAVEHDR) );
        waveInAddBuffer( hWaveIn, pWavInHdr3, sizeof(WAVEHDR) );
        SetDlgItemText(hwnd, IDC_TEXT1, TEXT("InBuf--3-processed"));
    }
    else if(pBufThatIsFull == pInBuffer4) //if "InBuf4" now full..
    {
        DigitalSignalProcessing( pInBuffer4, pOutBuffer4 );
        waveOutWrite( hWaveOut, pWavOutHdr4, sizeof(WAVEHDR) );
        waveInAddBuffer( hWaveIn, pWavInHdr4, sizeof(WAVEHDR) );
        SetDlgItemText( hwnd, IDC_TEXT1, TEXT("InBuf---4processed"));
    }
    return TRUE;

//279)===== Line 279 =====

```

Figure 8



A Pole Mounted Downconverter for 70 cm

By Pete Carr, WW3O, wb3bqo@localnet.com

Some of the microsats have been tough copy at my station. This is in spite of the fact that the antenna arrays are mounted at the top of a 35-foot utility pole. This is to help clear the nearby trees. The antennas are a 5-element 2 m with 4-element 70 cm combination Cushcraft Yagi and a 10x10 twist 70 cm antenna. I was using a Hamtronics 70 cm to 10 m downconverter in the shack along with a Uniden President 10 meter all-mode rig on downlink. Initially I thought about placing a preamp at the twist antenna and leaving the converter in the shack.

Back in the very old days of television satellite TVROs we used just such an arrangement. Back then there was a broadband amplifier at the dish, 50 ohm half-inch hardline cable from the dish to the head end and special receivers to decode signals to baseband. Later, the block downconverter was used at the dish to drop the receive frequency to L-band and reduce the signal loss in the cable.

The Hamtronics downconverter I use is a model CC-432-5 that converts 435-437 MHz to the 10 m band. It has a nominal gain of 20 db and a noise figure of 1-2 db, which is very similar to the specifications of a preamp. The

purpose of a preamp is to replace the signal loss in the cable that it feeds. For example, Belden 9913 coax has a specified loss of 2.6 dB per 100 feet at 400 MHz. The feed line from antenna to shack is 89 feet so I estimate a loss of 2.5 dB in the satellite downlink frequency range. The same feed line has about .75 db loss at 28 MHz. By placing the downconverter at the antenna there is a <2.0 dB increase in converter signal input. There is still plenty of gain to overcome the coax loss and the overall signal-to-noise ratio is improved. If I used a preamp at the antenna there would be 20 dB of gain minus the coax loss and another 20 dB gain at the downconverter. That's about 40 dB total; a lot more gain than is needed to drive the 10 m rig. In addition the noise figures would add since the two units would be in series. It just seemed better to use the downconverter alone and relocate it to the antenna.

On the transmit side, I choose to add a length of 9913 coax to the 70 cm section of the Cushcraft combination antenna. This is for satellites like VO-52 that use 2 m downlink and 70 cm uplink. The rest of the satellites I work are 70 cm downlink so the downconverter and 10x10 twist would be well used as a combination. The passive gain of the antenna coupled with the low noise figure of the converter and the low 10 m signal loss of the coax seems the best arrangement. As they say, if you can't hear 'em you can't work 'em.

The next question was the issue of powering the downconverter. After looking at several coax powered setups I decided to run a dedicated wire pair to supply 12 volts to the downconverter. Coax powered electronics have been around for a while but I wanted a power source that could be adapted to run other equipment as well. After building a small wooden box with mounting lip at the top I installed a terminal strip. This is where the 12-volt pair would terminate. The terminal strip also includes a green LED with 1500 ohm dropping resistor. This is wired across the incoming power terminals for visual indication that 12 volts is present. The downconverter has a single feed-thru type connector on the front panel between the coax connectors. I decided not to use that and wired in a piece of audio-type coax to the circuit board. This has spade lugs crimped on and is screwed to the terminal strip. This makes it easy to disassemble any of the parts for service.

A single TV mast clamp is used to connect the housing to the array support. The antennas are grounded vertically to a series of ground rods at the utility pole base. There is also a ground wire running with the coax into the shack. This grounds the radios and is also connected to the house ground system. It did not seem necessary to run a ground wire to the downconverter since it is grounded through the coax shield of the cables.



Photo 1: The enclosure installed at the antennas. Guess who forgot to bring the BNC to UHF adapter for the RX cable?



Photo 2: The satellite system prior to installation of the downconverter enclosure.

Tests using AO-51 do show an increase in reception. Since the satellite has some fading due to rotation and the atmosphere can give some variable attenuation I was not able to make meaningful measurements of signal-to-noise. However, it appears that I'm hearing the satellite over more of each pass and am especially pleased with reception near the local horizon. There is usually a high pass around 9 to 10 o'clock in the morning here at grid square FN-01 that goes by to the northwest. This means that slant range and local terrain are about the same on each pass. The comparison of reception with the downconverter in the shack and then on the pole shows that the work was worth the effort.

Resources:

http://www.hamtronics.com/rcv_conv.htm

<http://www.belden.com/ecat/pdf/9913.pdf>

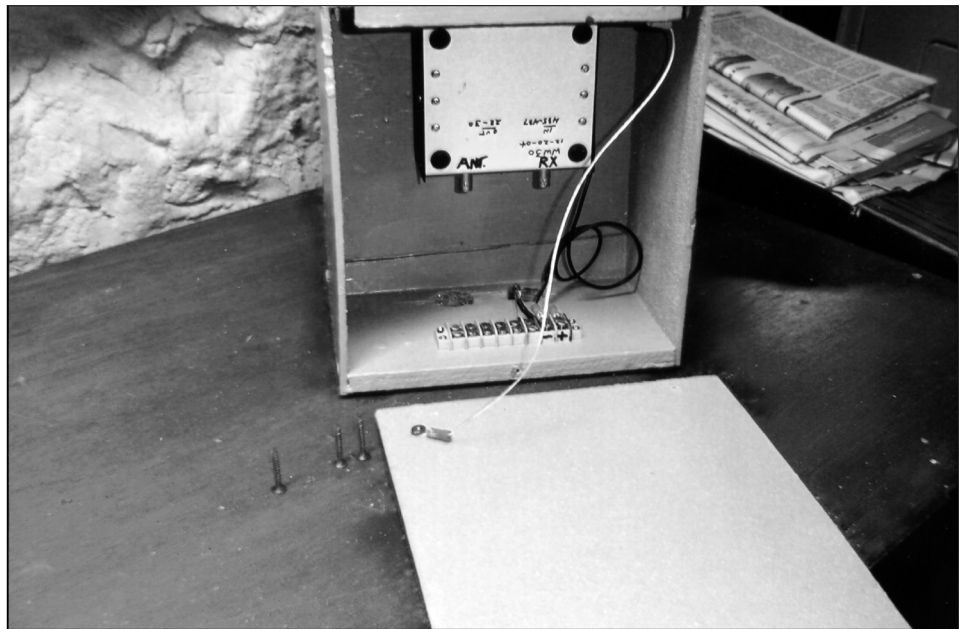


Photo 3: The downconverter is attached with Velcro and wired to the terminal strip. A green LED and dropping resistor indicate power.

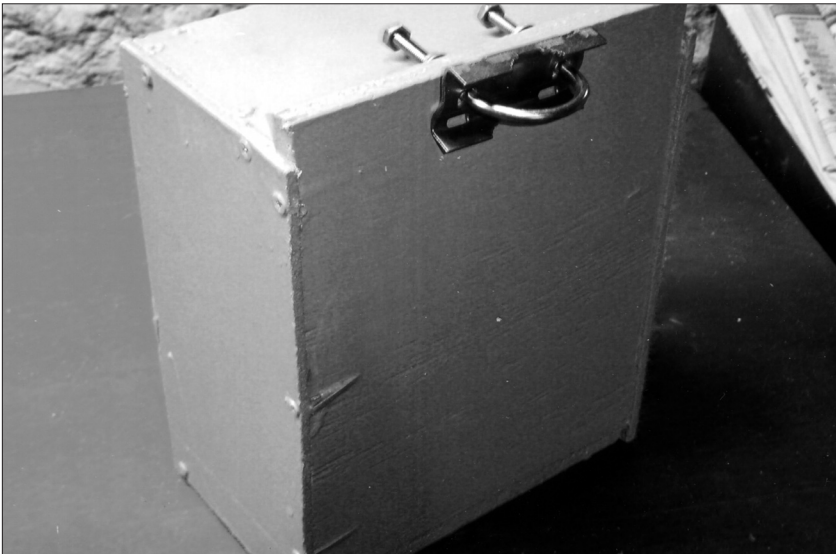


Photo 4: Rear of the enclosure. A TV mast clamp attaches the enclosure to a 1.25 inch mast.

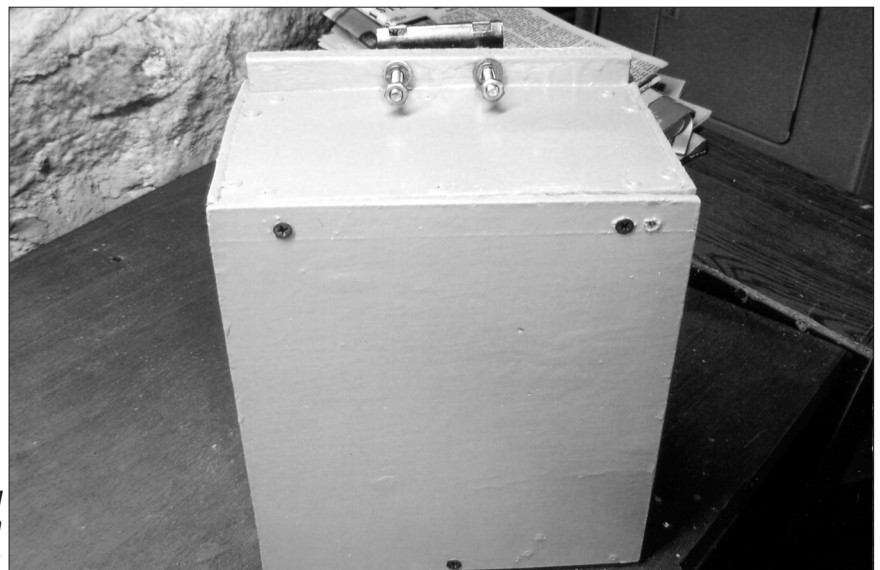


Photo 5: Front of the enclosure. The cover is secured with three screws. When removed it is suspended from the main box by a string.



AMSAT-DC Meeting Announcement

We will meet in Pioneer Hall at the Historical Electronics Museum. Same place as last year, same time as last year, for at least one more time.

Clip and share!

+++++

2008 AMSAT-DC MEETING AND SPACE SEMINAR

WHO: YOU are invited! Amateur Radio operators, students, educators and the public are all invited.

WHAT: Talks, demos, tutorials and socializing about amateur satellites and high-altitude balloon experiments in the greater mid-Atlantic USA area. A full day of activities!

WHEN: Saturday, March 15, 2008, starting at 11:00 A.M. local.

WHERE: Historical Electronics Museum (HEM) at 1745 West Nursery Road, Linthicum, Maryland 21090 (near BWI airport). In Pioneer Hall. HEM directions at <http://www.hem-usa.org/>

WHY: Fun, education, public service, training, cool stuff, and more fun.

HOW: Talk-in on 146.760 MHz (107.2 Hz PL on some receiver sites)

HOST: Pat Kilroy, n8pk@amsat.org or Patrick.L.Kilroy@nasa.gov

WEB: Check the AMSAT-DC page <http://patkilroy.com/amsat-dc/> for late breaking news.

+++++

Notes: Please download the AMSAT-DC-2008 flier from the AMSAT-DC Web page, print copies and share them widely, at a club meeting, at a hamfest, in a library, in a school and other visible and appropriate places.

Meeting coordination is being conducted on the amsat-dc e-mail list. Go to the AMSAT-DC page to subscribe or make changes.

Free paved parking is available a short walk from the museum front door. Like before, monetary donations will be accepted to help offset the associated meeting and seminar costs. Like last year, we'd like to in turn give a portion as a donation for the use of their facilities to the museum itself.

73 de Pat, N8PK ☺

AMSAT is the North American distributor of **SatPC32**, a tracking program designed for ham satellite applications. For Windows 95, 98, NT, ME, 2000, XP, Vista.

Version 12.7 now supports Labjack U12/U3/Piggyback, LVBTracker and W0LMD rotor controllers and Doppler tuning for Yaesu FT-817/857/897.

Version 12.7 Features:

- Select 2D/3D map with a single mouse click
- Select Political/Physical map with a single mouse click
- AOS voice announcement
- Countdown program displays next AOS of your favorite satellites
- Automatic Internet download of Keplerian elements.
- Graphical tracking on a world map with two selectable Zoom factors.
- One-click satellite switching using 12 "letter" buttons.
- Automatic rotor control support for: LVBTracker, Kansas City Tracker/Tuner, FODtrack, Uni_Trac, SatEL, Labjack U12/U3/Piggyback, W0LMD Mini/Junior/Senior Trackers, Yaesu GS-232, ARS from EA4TX, EGIS rotors, IF-100, RIF-PC, AMSAT-DL interface, WinRotor32, HalloRotor, and WiSP DDE clients.
- Doppler tuning with on-screen frequency displays. Radio models supported: Yaesu FT-847, FT-736R, FT-817, FT-857, FT-897 ICOM IC-820H, IC-821H, IC-910H and other ICOM radios Kenwood TS-790 and TS-2000 DDE client programs
- "Transparent" VFO-knob tuning in addition to keyboard and mouse tuning.
- "Virtual" VFO tracking for half-duplex transceivers FT-817, FT-857, FT-897.
- Includes a special version for ISS split-frequency operation.
- Controls subaudible tone on FT-847, FT-736R, FT-817/857/897, TS790A and IC-910H.
- Includes a non-graphical version and programs that output lists to the screen, printer, or a file.
- Interfaces with WiSP, with user-defined satellite switching priority.
- Includes a separate program for tracking the Sun and Moon.

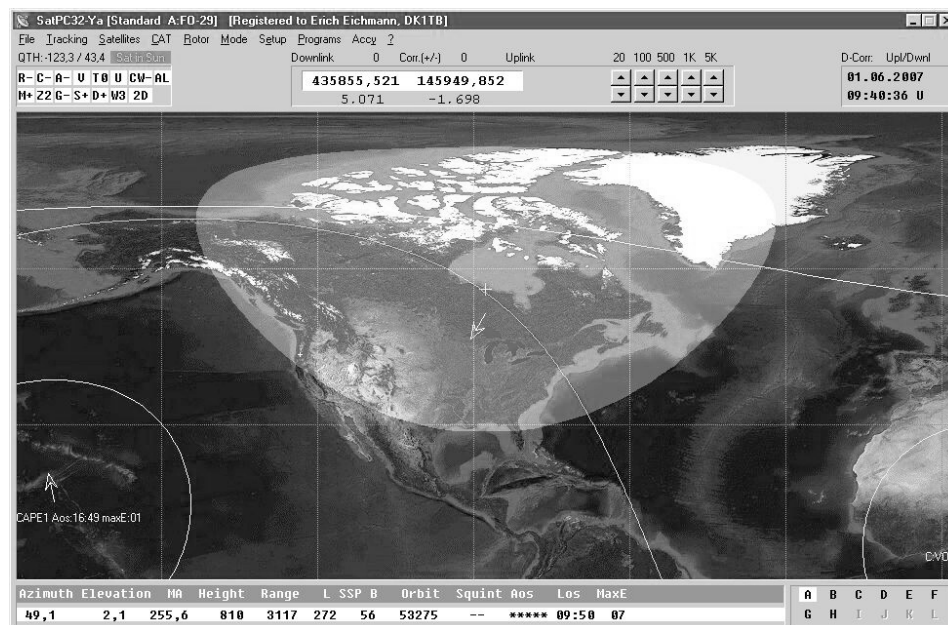
Price is \$45 for AMSAT members, \$50 for non-members, on CD-ROM.

A demo version may be downloaded from <http://www.dk1tb.de/indexeng.htm>

A registration password for the demo version is \$40 (members), \$45 (non-members).

Order by calling 1-888-322-6728, or use the online shop at www.amsat.org.

The author DK1TB donated SatPC32 to AMSAT. All proceeds support AMSAT.





LVB Tracker Box

- Reasonably priced and all profits go to AMSAT
- USB or serial interface
- Ethernet interface capable
- Open software
- Open architecture
- Built-in rotor interface cable with DIN connector
- Power supplied via the rotor controller cable
- Bi-directional interface allows the unit to read the rotor position
- LCD position readout
- Front panel manual control
- Self-programmable, allows for easy software upgrades
- Supported by the major tracking programs
- Uses GS-232A or Easycomm I/II protocols

Contact Martha at the AMSAT office 301-589-6062 to order.

The complete units will be built in groups, so get your orders in early.

Units will be shipped as they become available.

- 1) Bare board - \$20 + S&H – no parts kits available
- 2) Populated board, serial interface - \$100 + S&H – no kit with USB unit, rotor cable and LCD available, we do have a parts list with recommended part numbers and sources.
- 3) Custom Ten-Tec Enclosure powder coat, silk-screened, drilled/punched - \$50 + S&H
- 4) Complete unit - board, USB output, rotor cable, LCD, enclosure, serial chip - \$200 + S&H **our most popular

Documentation for the LVB Tracker can be found at: <http://www.LVBTracker.com>

Boards and complete units are available through the AMSAT Store.

The Classroom Satellite

Used by NASA, the U.S. Air Force Academy, and institutions around the world to give students and working professionals hands-on experience with satellites.

"I've been controlling satellites with reaction wheels for 20 years - now I really understand how they work!" - NASA Engineer

Find out more at <http://www.EyasSat.com> !

YOUR SATELLITE ANTENNA SOURCE

NEW! Ultra-gain!

436CP42-U/G
42 elements,
18' 10" tapered boom
(pair with 2MCP22)

436CP30
30 elements,
9' 9" boom
(pair with 2MCP14)

2MCP14
14 elements'
10' 6" boom

2MCP22
22 elements,
18' 6" boom

EB-144 & EB-432
Eggbeaters,
see 9/93 QST

- Stacking frames
- AZ & EL positioners
- Fiberglass crossbooms
- Power Dividers
- Phasing harnesses

M² 4402 N. Selland
Fresno, CA 93722
(559) 432-8873 FAX: 432-3059

The Orbital Classroom, Column #12

Lunar Link Analysis

© 2008 by Prof. H. Paul Shuch, N6TX

AMSAT Director of Education



The Orbital Classroom

In the previous Orbital Classroom column, we introduced the European and American Student Moon Orbiter initiatives (ESMO and ASMO, respectively) and mentioned that AMSAT may well have a role to play in their communications link and earth station design. In this installment, we will create a straw man system specification for a reliable digital link to cover lunar distances and discuss the antenna requirements for a capable command station. It should be noted that this column does *not* constitute an actual design proposal. Rather, it is my intent to show, by hypothetical example, the kinds of considerations that the ESMO and ASMO student designers (and their faculty advisors) will need to address in developing their own proposals.

The primary driver for any space communications link design is the power budget on the spacecraft itself. We consider the downlink to be limiting in that the spacecraft's power budget is finite (we can assume that the power available on Earth for uplink transmissions is virtually unlimited). For solar-powered spacecraft, the power budget is in turn limited primarily by the spacecraft's mass and physical dimensions. For the present study we will make the conservative assumption that the power budget will be no greater than available on a standard university CubeSat. [1]. The typical 10 cm cube of 1 kg mass, with high efficiency photocells covering six sides of the cube, readily produces (when in sunlight) at least 1 Watt (+30 dBi) of continuous-wave RF output in any one of the popular 145, 435, or 2400 MHz downlink frequencies common in the amateur satellite service.

For sake of this analysis, let us assume our downlink will operate at UHF, in the 435 MHz band. We will further stipulate that the spacecraft lacks attitude control, hence we will require an omnidirectional downlink antenna. Because it would be easy to stow and deploy, it is common practice to

equip CubeSats with a vee dipole for UHF uplink or downlink. Such an antenna can be assumed to exhibit a gain on the order of +2.2 dBi, yielding an Effective isotropic Radiated Power (EIRP) of +32.2 dBm.

Let us approximate the mean distance between Earth and Moon as 400,000 km. Over this distance, isotropic free space path loss at a wavelength of 70 cm is on the order of 197.3 dB. Subtracting this loss from the spacecraft's downlink EIRP, we see that the isotropic power incident upon the Earth will be on the order of -165 dBm. This is a weak signal to be sure, which will require substantial antenna gain to pull out of the noise.

Figure our ground station is going to be built around a large, fully steerable parabolic dish. Obviously, the larger the dish, the more gain the antenna exhibits, and the more downlink signal is recovered at Earth. But bigger is not necessarily better. The higher the gain of any antenna, the narrower will be its beam width, and the harder it will be to aim and track. Remember that the spacecraft is going to be orbiting the Moon, and is a vanishingly small target. A ground station antenna with beam width sufficient to cover the entire lunar neighborhood will certainly simplify matters, by lessening demands on the dish's tracking hardware and software. And, a little extra beam width will allow us a little slop in ground station operations, albeit at the cost of a bit of gain. Viewed from Earth, the Moon subtends $\frac{1}{2}$ degree in the sky. Let's say we're going to make our antenna beam width 2 degrees, so that when we point it at the moon, given even a 1 degree pointing error, the satellite's signals will still be captured.

OK, beam width in radians equals the diameter of the dish, measured in wavelengths. And two degrees equates to just under 40 milliradians, so our required antenna diameter will be $(1 / .04)$, or 25 wavelengths. Operating in the 70 cm band,

this dish will have a required diameter on the order of 18 meters.

Is an 18 meter dish even feasible, let alone available? As a matter of fact, yes, and quite a few dishes of this general magnitude are potentially within our grasp. In Bochum, Germany, for example, AMSAT-DL has not only succeeded in renovating a 20 meter parabolic antenna, but have successfully recovered signals from both the ESA's Mars Express probe, and NASA's Voyager 1 interplanetary probe, now beyond the edge of our solar system. Closer to home, on Table Mountain near Longmont, CO, another amateur group, the Deep Space Exploration Society (DSES) has been refurbishing a pair of 18 meter dishes on a 61 meter baseline, for both radioastronomical research and possible CubeSat command and control. Similar dishes exist in several other locations, leading me to speculate that, when the time comes, partnerships can be forged and collaborations set up, enabling us to secure the use of appropriate instruments to command and control these amateur lunar spacecraft.

OK, we've established that, for a 70 cm downlink, a command station dish on the order of 18 meters in diameter will produce an acceptable beam width. But, will it exhibit adequate gain? Fortunately, that's an easy calculation, as the maximum voltage gain of any dish approaches its circumference, measured in wavelengths. 18 meters times pi, divided by 70 cm, gives us a voltage gain of about 80. Power gain is voltage gain squared, or about 6400.

That figure, however, is best case, for a perfectly illuminated dish. Let's assume that our antenna's illumination efficiency is only 50%. We can thus expect half as much power gain, or a power ratio of 3200, which equates to +35 dBi.

Given our previously calculated incident isotropic power of -165 dBm, adding in the

[1] The anticipated mass and size of the ASMO and ESMO payloads is actually expected to significantly exceed the highly constrained CubeSat standards. However, if we can demonstrate a reliable Moon-Earth link with CubeSat-type power levels, we can certainly do all the better with larger and more powerful spacecraft.



The SETI League, Inc.			Link Analysis		
User specifies variables shown in Bold					
<u>Transmitter:</u>					
Frequency =	435 MHz;	λ =	69.0	cm	
Transmit Power =	1.0E+00 W =	0.0	dBW =	30.0	dBm
Eff. antenna diam. =	0.4 meters =	1	ft		
Illum. Efficiency =	50 %				
Computed Antenna Gain =		1.7E+00	Ap =	2.2	dBi
Antenna Half Power Beamwidth =		1.8E+00	radian =	1.0E+02	degrees
Effective Isotropic Radiated Pwr =		1.7E+00	W =	32.2	dBm
<u>Path:</u>					
Range =	1.30E-08 parsecs =	4.238E-08	LY =	4.0E+08	m
Free Space Isotropic Path Loss =				197.3	dB
Incident Isotropic Power =		EIRP - path loss =		-165.1	dBm
<u>Receiver:</u>					
Eff. antenna diam. =	18 meters =	59.055	ft		
Illum. Efficiency =	50 %				
Computed Antenna Gain =		3.4E+03	Ap =	35.3	dBi
Antenna Half Power Beamwidth =		3.9E-02	radian =	2.3E+00	degrees
Drift Scan time (zero declination) =		9.0E+00	min =	542.1	sec
Recovered Power =		P inc + G ant =		-129.8	dBm
System Noise Temperature =	100	K =	-4.6	dB/To	
Detector Noise Bandwidth =	2.00E+04	Hz =	43.0	dB/Hz	
Receiver Noise Threshold =	kTB =	2.76E-17	J/S =	-135.6	dBm
Integration Time =	5.00E-05	sec =	0.0	dB/cy	
SIGNAL TO NOISE RATIO				5.8	dB

Table 1

Lunar Link Analysis Spreadsheet (example). This spreadsheet can be downloaded from: <http://www.setileague.org/software/linkanal.xls>

above antenna gain suggests that something like -130 dBm of signal will reach our receiver. Is this enough signal to close the downlink? To determine that, we need first to compute receiver noise, and then derive Signal to Noise Ratio (SNR).

The receiver's noise threshold, found from Boltzmann's Law, is kTB, where k is Boltzmann's constant, T is the system noise temperature (let's assume 100 K, a fairly typical figure for good antennas coupled to decent preamps, with minimal feed line loss), and B is the bandwidth of the receiver, which must of course be compatible with the transmission bandwidth.

I'm going to arbitrarily assume a 20 kHz receiver bandwidth here, adequate for a 9600 Baud BPSK digital link (and fairly common for receivers used on our typical digital ham satellite links). Plugging in to Boltzmann's Law, we come up with a receiver noise threshold of -136 dBm. Good! Our noise is about 6 dB weaker than our signal, so we can boast a positive 6 dB SNR. Given reasonable error correction algorithms, this is sufficient to achieve a solid digital downlink.

Of course, if we desire a higher data rate,

or choose to use a different downlink frequency, we have to repeat the whole analysis, but you get the idea. The bottom line is, with daunting but not discouraging dishes, we can close the downlink loop from the Moon, with nothing more than a 1 watt transmitter into a dipole. Not that I'm proposing so simple a transmitter for ASMO

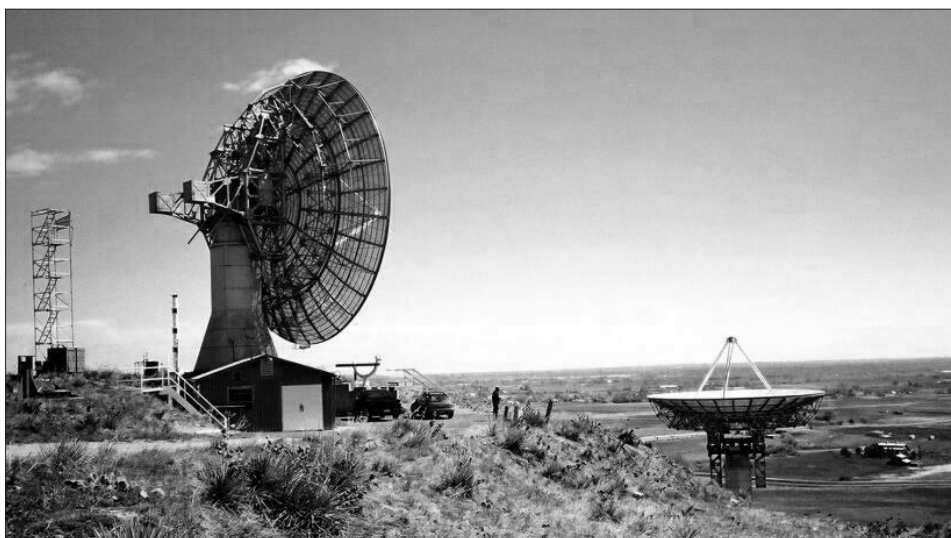
or ESMO, but if a single watt at UHF will do the job, then anything else will likely just make things better.

All the above are back-of-the-envelope estimates. For more precise calculations, we use a link analysis spreadsheet. The one I use (see Table 1) is actually designed for radio astronomy, so it has an interesting quirk: distances are input in parsecs! Fortunately, the spreadsheet converts this bastard unit first to light years, and then to meters – so I had to work backwards from the Lunar distance in meters, to determine what distance to plug in. There are a few other factors computed by the spreadsheet, that we have not discussed – but the bottom line shows an SNR very close indeed to what we estimated.

We have reviewed the tools and techniques necessary to analyze the lunar link. Should the students developing the ASMO and ESMO spacecraft so request, I'm sure AMSAT now stands ready to help them on their way to the Moon – and back. 🌕



The Bochum 20 meter dish.



18 meter dishes like these would be ideal for commanding the proposed Student Moon Orbiters (photo courtesy of the Deep Space Exploration Society).



AMSAT[®] President's Club! Join Now!

Contribute to **AMSAT[®]** directly through easy, automatic charges to your credit card.
Donations may be USA tax deductible. (Check with your tax advisor.)

Titanium Donors contribute at least US \$400 per month.

Every **Titanium Donor** receives gifts of:

☐ \$400 / month

- ✓ Everything at the Platinum Donor Level, PLUS:
- ✓ A very special, *hand crafted*, AMSAT President's Club Donor's pin.

☐ \$4800 one time

Platinum Donors contribute at least US \$200 per month.

Every **Platinum Donor** receives gifts of:

☐ \$200 / month

- ✓ Everything at the Gold Donor Level, PLUS:
- ✓ A very special, *hand crafted*, AMSAT President's Club Donor's pin.

☐ \$2400 one time

Gold Donors contribute at least US \$100 per month.

Every **Gold Donor** receives gifts of:

☐ \$100 / month

- ✓ Everything at the Silver Donor Level, PLUS:
- ✓ A personal invitation to the AMSAT Dayton dinner (free).

☐ \$1200 one time

Silver Donors contribute at least US \$50 per month.

Every **Silver Donor** receives gifts of:

☐ \$50 / month

- ✓ Everything at the Bronze Donor Level, PLUS:
- ✓ A personal invitation to a reception with the AMSAT Directors, Officers and project designers and builders (free).
- ✓ Annual endorsement sticker after each year of donation.

☐ \$600 one time

Bronze Donors contribute at least US \$25 per month.

Every **Bronze Donor** receives gifts of:

☐ \$25 / month

- ✓ A unique "AMSAT President's Club" certificate.
- ✓ A specially designed AMSAT President's Club Donor pin.

☐ \$300 one time

Core Donors contribute at least US \$10 per month.

Every **Core Donor** receives gifts of:

☐ \$10 / month

- ✓ A specially designed AMSAT President's Club Donor pin.

☐ \$120 one time

Choose where your contribution should go:

☐ AO-Echo ☐ AO-Eagle ☐ ARISS ☐ Future Projects ☐ General Fund

☐ RENEW my
President's Club
AUTOMATICALLY
every year!

☐ I prefer to make my donation in one yearly payment of \$ ____.

(Credit card only, please.)

THANK YOU!



AO-16 Reconfigured for Voice Service

Andrew Glasbrenner, KO4MA, ko4ma@amsat.org

AMSAT-NA VP Operations

(modified from an [amsat-bb](#) post on January 22, 2007)

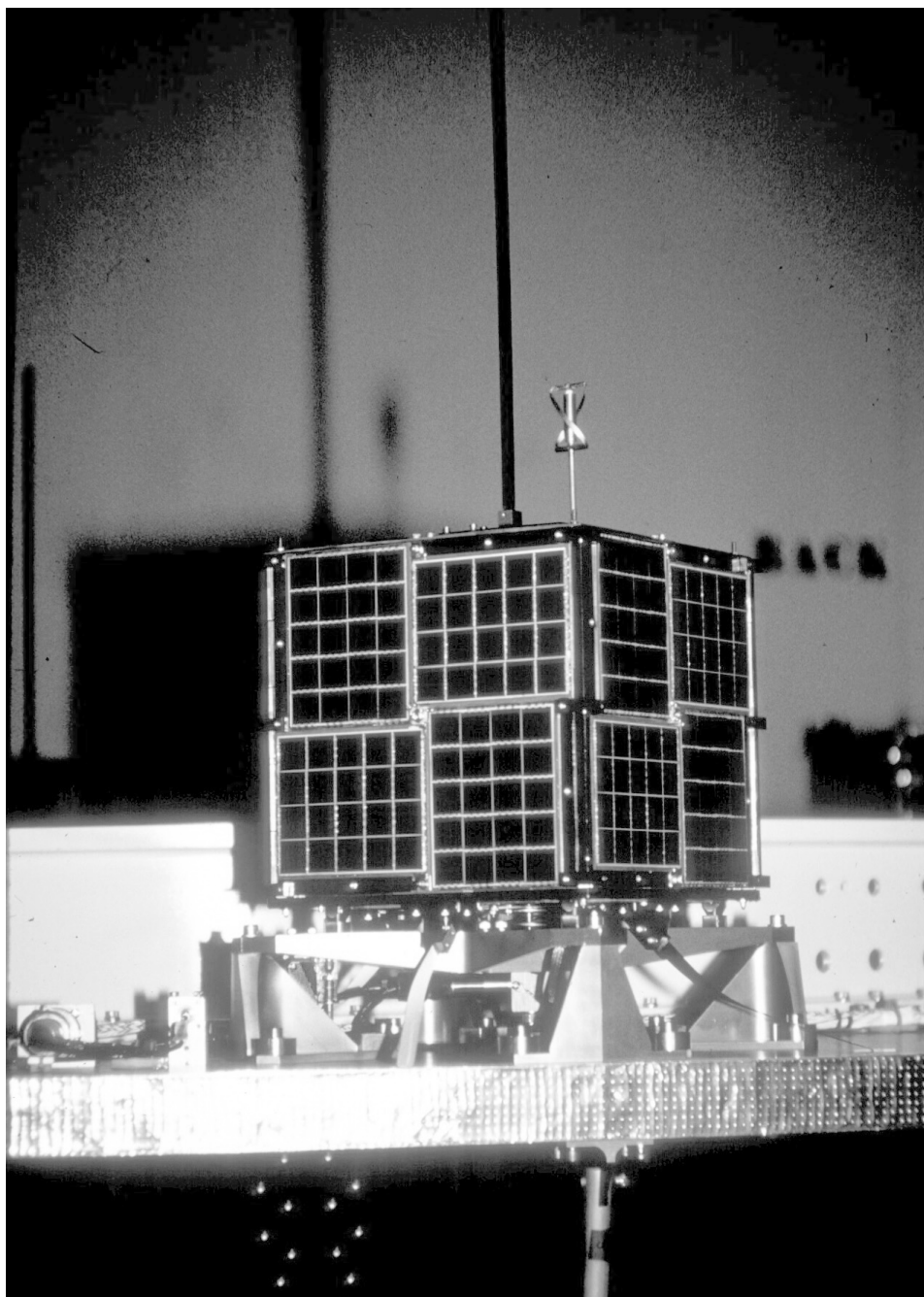
Since AO-16 was recovered approximately 6 months ago, the command team attempted to reload the satellite software almost a dozen times without success. Subsequently a series of memory tests were performed which points towards a hardware failure that prevents restarting the spacecraft software successfully. This team included Bruce

Rahn, WB9ANQ, and Jim White, WD0E, advising Mark Hammond, N8MH, as the primary ground station. Mark put in many early hours during the multiple reloads and test sessions, with Bruce, Jim and others advising. Thank You to all involved for your hard work.

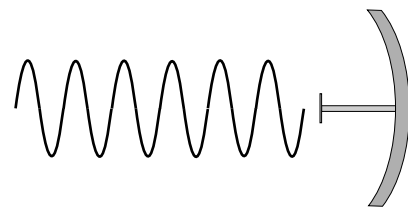
After reaching the conclusion that the spacecraft computer system was damaged

and as discussions about decommissioning were taking place, Jim recalled a series of low level commands included in the spacecraft design by Tom Clark, K3IO, during construction. One of these commands allows an uplink receiver to be directly tied to a downlink transmitter. The twist is that the uplink is regular FM but the downlink via the BPSK transmitter is close to DSB (double sideband), but with a small amount of carrier. Mark placed the satellite in this mode early this week and some testing was undertaken. The satellite hears VERY well, and the reduced bandwidth by using either USB or LSB on the ground station receiver allows for a very robust downlink. Tuning the downlink is just like on a linear transponder, meaning it is tight and with fast Doppler. Uplink tuning is not required, just as with the FM mode V/U satellites. QSOs were made between N8MH, WD4ASW, KO4MA, K5QXJ and WA6FWF. My personal observations include being able to access and hear the satellite within one degree of the horizon, much lower than any other current bird for my QTH. This should be an easy satellite with omni-directional antennas and a 70cm preamp.

With that explanation, I'm happy to open the satellite to general use on voice for a test period. Please submit reports either to the -bb or to ao16@amsat.org. The uplink is currently 145.920 MHz FM and the downlink is 437.026 MHz SSB +/- Doppler shift. Please restrict your uplink power to a reasonable level and do not transmit without being able to hear the downlink. All the general single-channel guidelines apply and please make room for everyone. Enjoy this bird's new life! 🌐



AO-16

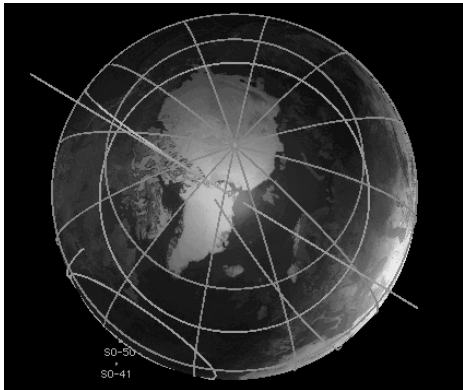


AMSAT now offers a 2GB Flash Drive with the AMSAT logo. Save your stuff and show your support for AMSAT. \$30 + Shipping



MacDopplerPRO X

The premier Satellite tracking and station automation application for the Macintosh - OS 9 & OS X



MacDopplerPRO X gives you a seat right in the heart of the Operations & Command Centre for every satellite in orbit. In fact up to thirty two front row seats at the same time, providing any level of station automation you need from assisted Doppler Tuning and Antenna Pointing right on up to fully automated Satellite Gateway !

It will calculate the position and relative velocity of the satellite you are tracking and automatically adjust the Doppler shift on both transmit and receive as well as pointing your antennas with predictive dead spot crossing so that a pass is never interrupted by the beam heading passing a dead spot.

MacDopplerPRO X provides separate windows for the map (2D or 3D), the radio controls, and the sorted table of upcoming satellite passes. A Horizon window graphs upcoming passes as a function of elevation over time for status at a glance.

Now available at a special member discount price from AMSAT !

martha@amsat.org
850 Sligo Ave.,
Silver Spring MD,
20910-4703 USA.
(301) 589-6062, (301) 608-3410 (Fax)

Dog Park Software Ltd.
www.dogparksoftware.com

Do you still use manual tuning to remove Doppler changes? Why not automate?

Uni-Trac 2000 will automatically tune your Receiver (and Transmitter) to compensate Doppler frequency changes. Uni-Trac will also STEER your Antenna !

Uni-Trac 2000, including Interface Cable \$280.00
FOB Concord, Mass. 01742, USA.



Spectrum International, Inc.,
P.O. Box 1084,
Concord, Mass. 01742, USA.
Tel: (978) 263-2145
Fax: (978) 263-7008

SSB ELECTRONIC USA

PHASE 3D Equipment Headquarters

SSB Electronic USA features world class VHF - UHF - SHF equipment. The latest gear from: SSB Electronic, Kuhne Electronic - DB6NT, M2 Antennas, Beko Electronic, EME, Procomm, AIRCOM PLUS, AIRLINK, ECOFLEX and WINRADIO is available.

- Mast Mounted Preamplifiers 144 - 2400 MHz.
- Ultra Low Noise LNA's 50.0 MHz. 24.0 GHz.
- Transverters 50 MHz. - 24.0 GHz.
- Antennas - Rotors
- Downconverters and TX Upconverters for all P3D frequencies
- Mode "S" Downconverters
- Mode "L" TX Upconverters
- Linear Amplifiers 50 MHz. - 24.0 GHz.
- Ultra Low Loss Coaxial Cable
- Transverter Kits 1.2, 2.4, 5.7 & 10 GHz.
- Parabolic Dishes

So What's New ?

BEKO Electronic: 144 MHz. - 1296 MHz. Linear Amplifiers 100 Watts - 1200 Watts

DB6NT Electronic: MKU 24 OSCAR Mode "S" Downconverter IF 144 or 432 MHz.
MKU 10 OSCAR 10.451 GHz. Down Converter
MKU 24 G2 OSCAR 2.4 GHz. Transverter 1 Watt
MKU 57 OTX 5.6 GHz. OSCAR TX Upconverter *plus more.....*

ECOFLEX - LLC Super Flexible Low Loss Coaxial Cable

SSB Electronic: UEK-3000SAT Mode "S" Downconverter IF 144 or 432 MHz.
UTM-1200 DLX Mast mounted 1269 MHz. 15 Watt TX Upconverter
UTM-1200-1 1269 MHz. 1 Watt TX Upconverter
SP-2000 & SP-7000 Heli-Filtered Mast-Mounted Preamps *plus more.....*



SSB
Electronic USA

For complete specifications and prices, please visit our WEB SITE: www.ssbusa.com

Phone 570-868-5643

New Hours: MTWTFSS
9:00 AM - 11:00 PM

124 Cherrywood Dr.
Mountaintop, PA 18707



AMSAT Marketing

Dan Briner, AB3EN, ab3en@amsat.org
AMSAT Vice-President Marketing

The AMSAT organization is powered by many individuals working in many different capacities. From engineering to taking AMSAT's message to interested groups, we are first and foremost a volunteer driven organization. I am just one of many volunteers, one who just happens to have a background in formal marketing.

The prospect of having a geosynchronous satellite, the ongoing work with AMSAT's Satellite Integration Laboratory in Pokomoke, Maryland, the expected completion of AMSAT-DL's Phase 3 Express high earth orbit satellite, and the beginning of construction and testing of AMSAT's Eagle are all projects of great importance to the Amateur Radio community as well as communications in general.

The proposed geosynchronous satellite will change the field of Amateur Radio satellite communications. This satellite with enhanced communications capabilities is for me the most exciting development in Amateur Radio in the last 30 years.

Like most of our AMSAT members I have a deep interest in Amateur Radio and a lifelong fascination with satellites. I was just 12 when the first satellite went overhead and I grew up in the era with an explosion in the field of science with new technological advances daily. My interests turned to computers and marketing in the late 1960's and over the years I have enjoyed working in both fields. Today I server as the Director of Information Technology for Washington County Pennsylvania and I am very active with our Public Safety department and its related computer and radio needs.

I joined AMSAT to help me understand and explore the opportunities and challenges of satellite communications. It has been a wonderful resource and when the organization asked for help with marketing issues I volunteered. In fact two of us volunteered, my friend and other marketing resource Steve Kenwolf and I have been working for the last couple of months on several projects that we hope will enhance

the ability of AMSAT to get the message out and make more resources available to our members.

In the near future you will see a refreshed AMSAT logo, and other changes designed to enhance the recognition of the AMSAT name. For folks developing presentation material we will shortly have a few presentation themes and templates to help ensure consistent AMSAT identity. On our to-do list is developing some members only resources to enhance the value of AMSAT membership and we are looking forward to working with many of our other volunteers helping to refine and polish their efforts with a little marketing input.

We welcome input from other AMSAT members on what we can do to better address needs for marketing and look forward to working with other volunteers to help with either the more formal side of marketing or the equally important activities such as writing articles for our publication, public presentations and general communications.

73,

Dan Briner, AB3EN
VP, AMSAT Marketing



Letters

Dear Editor:

I read with interest the AMSAT in Education column by Paul Shuch, N6TX, in the September-October 2007 edition of the *Journal*. As an attorney who spends a fair amount of time on export control matters, I found his perspective on the relationship between the International Traffic in Arms Regulation (ITAR) and AMSAT's educational mission a useful counterpoint to the federal government's sometimes irrational approach to industrial security and arms proliferation. I believe, however, that Dr. Shuch has overstated his case.

First, the export restrictions imposed by ITAR are much more limited than the casual reader of Dr. Shuch's column would understand. They are focused principally on items and technologies that no one would have much difficulty in classifying as a weapon -- nuclear devices, certain radiological materials, chemical and biological materials and technologies, certain explosives, conventional arms, etc. In the area of immediate concern to amateur

satellite builders, there actually are few ITAR limitations. One of Dr. Shuch's examples, triple junction photovoltaic arrays, are not included under ITAR restrictions unless they have been specifically designed or modified for military applications. The same goes for space qualified telecommunications systems and the technology required for development of such systems. Therefore, unless the amateur satellite developer is planning on including genuine weapons technology on his satellite, the ITAR is not an impenetrable barrier to progress in amateur satellite development. Similarly, the Export Administration Regulation (EAR) administered by the Department of Commerce includes restrictions on the unlicensed export of certain items and technologies that could fall within the potential scope of amateur satellite development. Again, in most cases, these restrictions are quite specific and narrow and are not likely to be relevant to the technologies employed in amateur satellites.

This is not to say that either ITAR or the EAR

simply can be ignored by satellite developers working with their non-U.S. counterparts. In some cases, it may be prudent for the development team to analyze the issue, rather than simply assuming that one of these export control regimes either does or does not apply. In the highly unlikely event that a technology or component would require an export license, the EAR procedure in the vast majority of cases is not as burdensome as Dr. Shuch suggests. The ITAR license procedure is more difficult, but is even less likely to be implicated by amateur satellite work.

If educational or other non-profit organizations have specific questions on this topic regarding their amateur satellite projects, I would be happy to make my contribution to AMSAT's mission by consulting with them.

Jonathan T. Cain, N4SUP
701 Pennsylvania Ave., NW
Washington, DC 20004
Phone: 202.585.3508 | Fax: 202.434.7400
E-mail: jtcain@mintz.com 



Global RF Surveys with the AO-51 SQRX Tunable Receiver

Andrew Glasbrenner, KO4MA, ko4ma@amsat.org

AMSAT-NA VP Operations

One of the many unique aspects of the AMSAT satellite AO-51, known before launch as AMSAT-Echo, is the inclusion of a multiband, multimode receiver known as the SQRX. The SQRX receiver was provided by SpaceQuest, Ltd. and the exact specifications can be found at: <http://www.spacequest.com/products/MultibandReceiver.pdf>.

The SQRX is used primarily as the digital uplink receiver for the BBS and digipeating functions on AO-51, as well as the receiver for any L band or SSB uplinks such as used for the L/U, L/S or V SSB/U FM repeaters. An onboard interference issue was discovered in early 2007 that has led the command team to limit use of the SQRX on V band uplinks. Although still functional on V band, we try to minimize risk whenever possible.

The SQRX has the ability to output a digital stream of signal strength data that is inserted into the telemetry stream and Whole Orbit Data (WOD) onboard AO-51. This telemetry channel is known as the RSSI, or Received Signal Strength Indicator and is available whenever the SQRX receiver is active. This ability has been used to do some interesting global RF surveys, which are presented in this article.

Figure 1 is one of the first surveys I was involved with using AO-51. Mike Kingery, KE4AZN, collected this data set in 2005 on 145.880 MHz. Mike provided a set of latitude and longitude coordinates for the satellite sub-point at each sample interval on this first survey. On subsequent surveys I have generated these locations with various satellite tracking programs. After offsetting the satellite locations to match the current offset of the onboard clock on AO-51, I created an Excel worksheet with time, latitude, longitude and RSSI columns. This file was used to create a grid file in the Surfer contouring software. The grid size used was one by one degree, and utilizing Kriging as the interpolation algorithm. Kriging is an interpolation method commonly used in the geological sciences, my area of expertise, and the method I feel most confident using. A mathematician may very well disagree with this method in this application!

After gridding the data, I created a contour map of the RSSI values. The contour map assumes a fixed distance between straight latitude and longitude lines, resulting in what is known as equirectangular cylindrical projection, one of the oldest and simplest map projections. Many tracking programs use this projection. I overlaid this contour

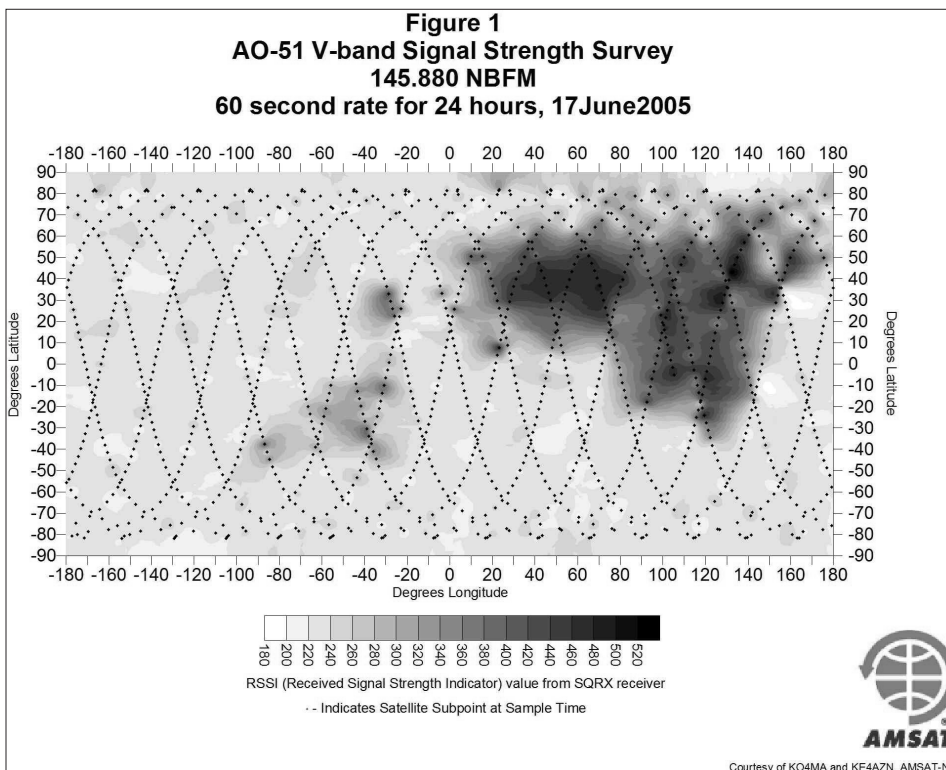
map with the location of the satellite at each data point, which makes a nice ground track. Along the left and right axes, latitude is indicated every 10 degrees, and longitude is indicated every 20 degrees along the top and bottom axes. I'm still working on a good way to overlay an outline of the continents.

The methodology for this survey is very simple, and has some limitations that should be kept in mind while attempting to interpret the data. The collected RSSI data is assigned to a single location (the satellite sub-point) when in reality it could come from anywhere within the footprint. This is somewhat tempered by the difference in path loss from a signal source directly beneath the satellite, and that of a source on the edge of the footprint. Separate orbits passing over the same or nearby points may result in conflicting data if the signals are not constant in nature. From observation we know that many of the non-amateur signals on 2 m are things like telephones and taxicabs that are intermittent in nature, so to limit this sort of problem I limit the data set to 12 or 24 hours in length.

Some obvious and interesting trends are observable in the map. Asia and Northern Indonesia are practically outlined by the highest signal strength areas. Surprisingly, the worst area within Asia seems to be between 20 to 50 degrees N and 30 to 80 degrees E. This area includes the Middle East and the Central Asian countries, including those sometimes referred to collectively as Turkestan. Often within the footprint of AO-51 while over Europe, these signals may be the source of significant interference.

China, Southeast Asia and Indonesia also exhibit a very high signal level. Comments from Australian and Japanese amateurs on the level of interference to Mode V/U satellites over this part of the world are well supported by this data. Curiously, despite the large population of India there seems to be relatively lower signal levels there than the surrounding countries.

Other smaller hotspots are present in the Mid and South Atlantic. I initially thought these may be land based emissions picked up along the edges of the footprint. However, since the signals do not appear as strong or stronger on the orbits directly over the adjacent land masses, these may originate



with maritime activities such as fishing or shipping fleets.

Figures 2 and 3 represent a survey more recently completed at the request of Graham Shirville, G3VZV on behalf of ARISS Europe. L/S antennas have been installed on the Columbus module of the ISS, which at the time of this writing sits on the pad inside the Atlantis payload bay awaiting launch. The radio hardware to attach to the antennas is as of yet unbuilt and will be launched and installed subsequent to the module being added to the ISS. ARISS is concerned about possible radar interference to L band uplinks and asked that we perform a pair of surveys comparing the signal levels at 1263 and 1268 MHz. These surveys were performed on December 29th and 30th, 2007. AO-51's chief command station, Gould Smith, WA4SXM, set up the satellite in the required mode and collected the WOD files.

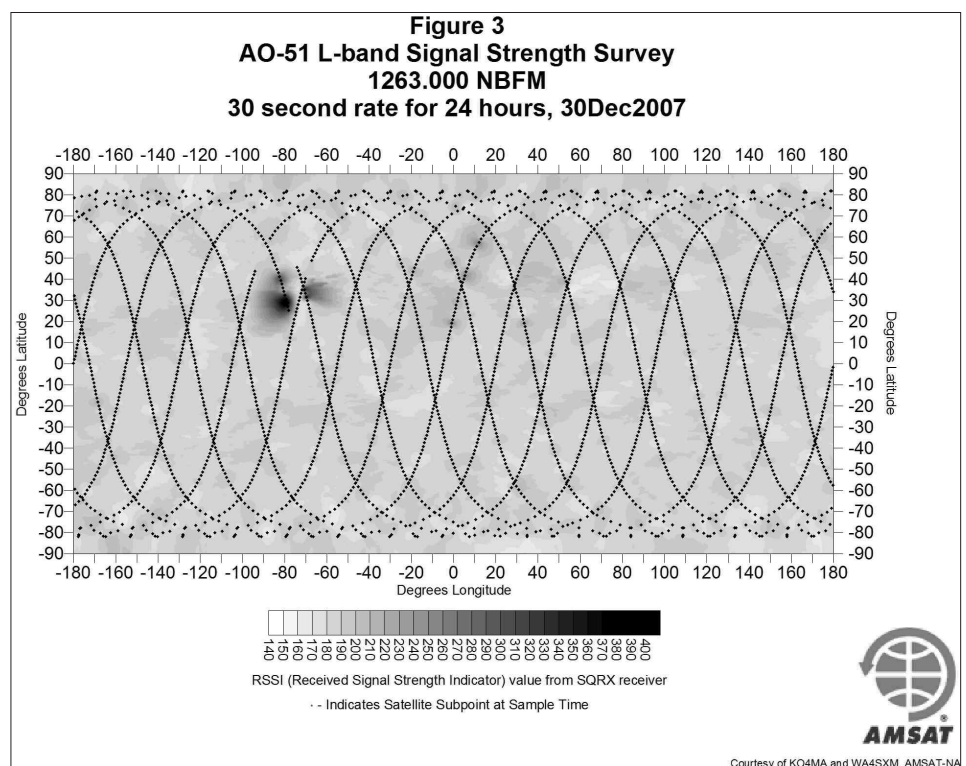
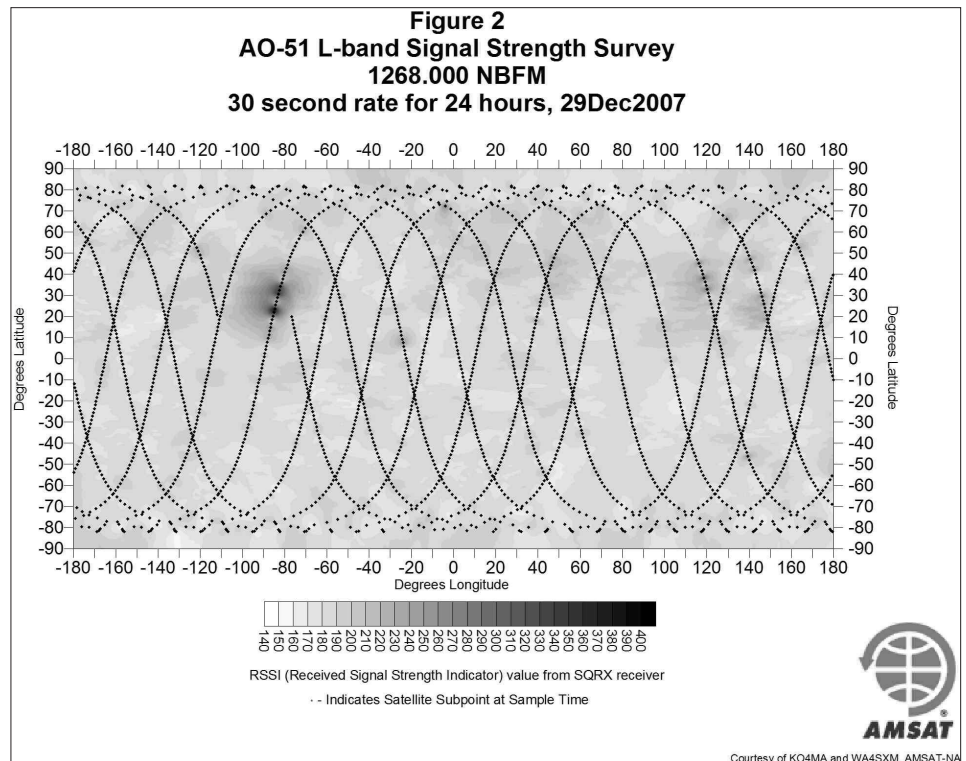
In an effort to better calibrate signal levels to recorded RSSI values, I transmitted a calibration signal from my station continuously throughout all passes over my station during the surveys. A 350-watt EIRP FM carrier was transmitted from my station with full Doppler tuning and auto tracking antennas. My uplink antenna is linearly polarized loop Yagi, and the L-band antenna on AO-51 is also linearly polarized. This results in some extreme fades that are very noticeable when operating the L/S and L/U modes, and the same held true in this survey. Observable fluctuations in signal strength is visible along the ground track near my QTH at ~28 degrees N and ~83 degrees W. This may also be in part due to my rotor system reaching the azimuth stop and turning 360 degrees to reacquire the satellite.

Comparison of the two L-band surveys suggest there is little to worry about on L-band at LEO with an FM receiver. However, due to the pulsed and swept nature of a radar signal, these results may be misleading for wideband or transponder systems. The data also suggests that the alternative frequency of 1263 may also exhibit slightly higher background levels, although this may be internal to the spacecraft or the SQRX receiver.

It is my hope and intention to record more surveys of this nature using AO-51. I would be interested in hearing from any AMSAT related groups that would benefit from a survey on a particular frequency or mode. Interested parties can reach me at ko4ma@amsat.org, and I would be happy

to discuss specifics with them. I would also be interested if anyone has a file to share that consists of a series of latitude/longitude points along the outline of the major continents of the world. This would improve my ability to display and interpret

these surveys. My thanks to Mike Kingery, KE4AZN, and Gould Smith, WA4SXM, for providing the WOD files, and to Tom Clark, K3IO, for comments on the surveys and encouragement to take the time to publish them. 🌐



News from the ZEL – A P3E Update Part II

Gould Smith, WA4SXM, wa4sxm@amsat.org

with information from Hartmut Päsler, DL1YDD, Peter Guelzow, DB2OS and Achim Vollhardt, DH2VA

We talked about the ZEL moving to smaller quarters over the holidays. Hartmut reports that “The move is nearly finished. We hope to be completely operational again soon.” Although the size of the ZEL is now smaller than before, approximately 330 square meters (3500 square feet), it is definitively a good satellite lab.

The first things that will be done in the new configuration will be to work on the IHU, CanDo, LIU, SEU and HELAPS modulator.

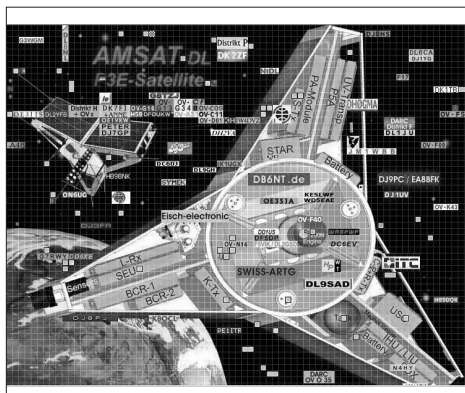


Figure 1. AMSAT-DL Purchase a Pixel Program

Hartmut says “Our very first goal for the next time is funding. This keeps all of us extremely busy and we put all other activities into a lower priority in favor of the funding efforts.” You can help by donating to the P3E fund either at the AMSAT Store and specify



Figure 2. P3E with both types of solar panels during a test fit.

the donation for P3E, or on the AMSAT-DL Web site, <http://www.amsat-dl.org> and click on the Spenden/Donations text in the upper right. There is the Buy a Pixel promotion going on also, where you can donate to select pixels and add your callsign, graphic

or a short message to cover a P3E graphic. <http://www.p3e-satellite.org/index.pl> or click on the large graphic in the center of the amsat-dl.org page.

P3E Systems

To help everyone understand P3E better and what they are looking at it is important to understand the underlying structure and nomenclature of the modules. Here is the breakdown of the satellite modules and module names. We will cover each of these systems over the next few months.

P3E will have a mass of about 150 kg at liftoff, and about 90 kg once the fuel has been burned. The spacecraft is 50 cm (19.6”) tall and wing-to-wing measures 1.2 m (48”).

Power System Solar Cells

The solar cells for P3E were provided by RWE Solutions. ASTRIUM/EADS assembled them into seven solar panels. Six will be used on P3E. Two of the panels are made using very high efficiency GaAs (Gallium Arsenide ~27% efficient) cells able to produce up to 49W. Five panels were made using high efficiency Si (Silicon ~13% efficient) solar cells with a maximum power of 35W. The panels are protected with a 500 µm thick cover glass and each panel weights about 5 kg. These are complete and ready to install.

BCR 1 (Battery Charge Regulator)

Similar to the BCR used in P3-A, P3-B and P3-C. The BCR for P3E is being designed and built at the University of Budapest led by Andras Gschwindt, HA5WH. The BCR will supply regulated power to all the satellite

Systems/Modules	Module Names	Subsystems
Wiring Harness		
Coax cables		
CAN-DO system		
Fuel tank		
Magnetorquer system		
Solar Arrays 1-6		
Power Splitters		
Diplexers		
220 N motor		
Helium bottle		
Propulsion structure		
Release system		
Attachment system		
E01	Main Battery	
E02	S-TX	2.4 GHz Exciter
E03	VS-PA	145 MHz Power Amplifier (HELAPS)
	Ant	V-High Gain-1, -2, -3
	Ant	V/U Omni
		2.4 GHz Power Amplifier (HELAPS)
	Ant	S-Omni
	Ant	S-High Gain-1, -2, -3
E04	K-TX	24 GHz Transmitter
	Ant	K Dish
E05	P5-XP	P5 S/X Experimental Coherent Transponder
	Ant	X-Omni
	Ant	X-Dish
E06	UV/SDX	435/145 MHz (SDX) Transponder
	Ant	V/U Omni
E07	L-RX	1.2 GHz Receiver
	Ant	L-High Gain
	Ant	L-Omni
E08	SEU	Sensor Electronic Unit
		3 Magnetorquers
		Sun Sensors 1 & 2
		Earth Sensor
E09	BCR	Battery Charge Regulators 1 & 2
E10	Auxiliary Battery	
E11	IHU-3	Integrated Housekeeping Unit
E12	USO	Ultra Stable Oscillator
E13	LIU	Liquid Ignition Unit
		Motor Valves
		He Valves, S/A Plug
E14	Star Sensors (Top and Bottom)	
E15	R-TX/C-RX	5.67 GHz Receiver/ 47 GHz Transmitter
	Ant	C/R Dish

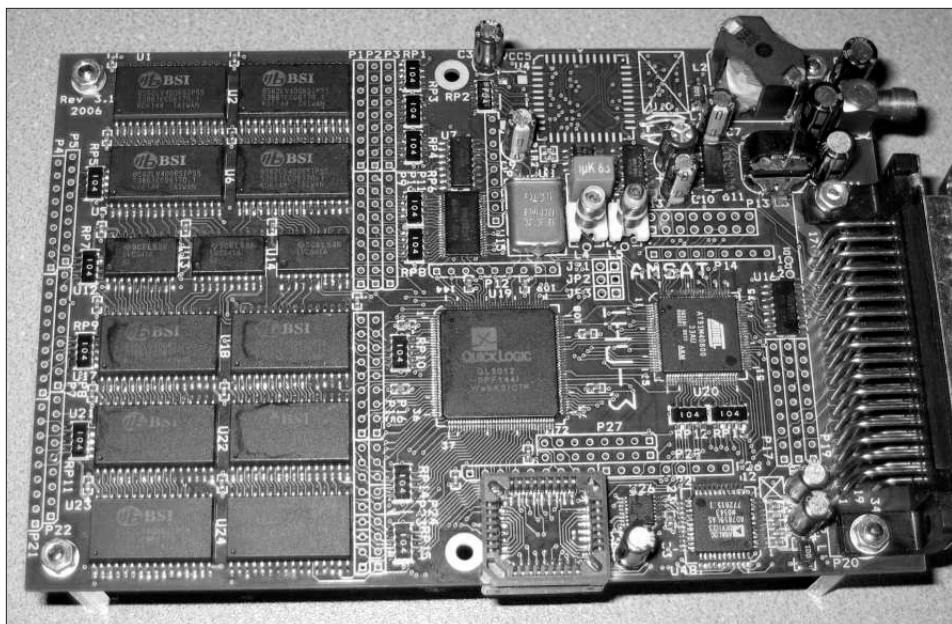


Figure 3. The IHU-3 revision 3.1 board

systems and charge the batteries. A primary task of the BCR is to constantly determine how much power is used from the solar cells and how much from the batteries. The BCR will manage an input current from the solar cells of <2.7A, with a maximum input power of 92W. The nominal input voltage for the BCR will be 34.32 V, with a maximum of 45 V. There is some more work to be done on this module.

Main Batteries (E01)

The main battery system for P3E consists of 10 Ni-MH (Nickel - Metal Hydride) cells, made by Suppo with a 13 Ah capacity. AO-13 had a 7 Ah battery capacity. These cells

were carefully tested, cycled and matched. Both the main flight battery and main test battery are completed.

Auxiliary Batteries (E10)

The auxiliary batteries for P3E are also composed of 10 Ni-MH, these are made by Suppo and have a 4 Ah capacity. Two sets of these were produced, with one set going to AMSAT-ZL for KiwiSat. These batteries are also completed.

Control System

IHU-3 (Integrated Housekeeping Unit) E11

The IHU-3 board has been “re-spun” by AMSAT-DL to correct initial layout problems.

This is standard practice for complicated boards. They are now ready to update the housekeeping software and begin controlling the spacecraft modules via the CanDo interface. The IHU-3 board uses an ARM7TDMI based CPU from Atmel running Karl Meinzer’s IPS operating system, ported to this processor. The IHU-3 is also planned to be used by AMSAT-DL for P5A and may be used by AMSAT-NA for Eagle and the Phase 4 payload. IHU-2 was flown aboard AO-40, and the original IHU was used on the first three Phase 3 satellites, P-3A, AO-10 and AO-13.

Rick Hambly, W2GPS, announced on the 17 January 2008 Florida AMSAT Net that he had a desktop full of additional CanDo! modules ready to ship to AMSAT-DL for P3E. These modules are now in route to AMSAT-DL.



Figure 4. The Sun and Earth sensors mounted on the P3E structure

Other Modules

SEU (Sensor Electronic Unit) E08

These are the Sun and Earth sensors. The large tubular device in Figure 4 is the Earth sensor, the lower set of two sensors are the Sun sensors. The Earth sensor is covered by a plastic cap to protect it since it is an optical system. It is quite a long device, that’s what you see on the photo going into the structure. The two slits of the sun sensor are protected by orange transparent tape. The sun sensors are basically “only” diode light sensors behind two slits.

These sensors are complete and installed in the satellite structure.

C-Band Receiver E15

Volker Winterscheid, DF7IT completed the development of the C-band receiver in December 2007. Volker designed the receiver and did the board layout. Achim Vollhardt, DH2VA built and tested the receiver. In the available volume of 74x74x30 mm³, is the 5.6 GHz front-end, the mixer to 10.7 MHz and the transponder passband filter with integrated AGC. This is the first time an IQ mixer with subsequent 90 degree hybrid is used for image frequency suppression. Except for setting the AGC time constant, all electrical work on the module is complete. After some final mechanical work, the module will be directly exposed to a local weather radar signal to check its immunity to this particular interference source.

More will follow in the next issue. See the following for more photos and information:

References

<http://n4hy.smugmug.com/AMSAT/245805> N4HY photos of P3E

<http://www.amsat-dl.org/p3e/> for P3E documents and photographs

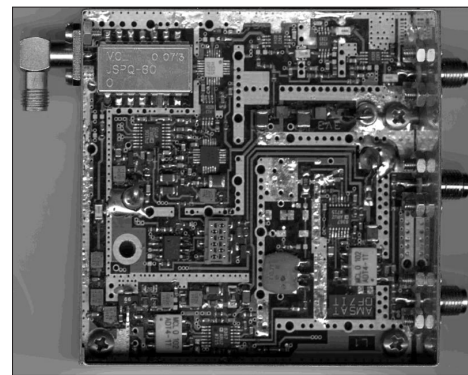


Figure 5. The P3E C-Band receiver board by DF7IT



PROCEEDINGS OF THE AMSAT-NA

2006 Space Symposium and AMSAT Annual Meeting

Held October 6-8, 2006 in San Francisco, CA

Contents include articles on Echo, Eagle, ARISS, Ground Station User Equipment, University Satellites and much more! For example:

- Software Radios: An Enabling Technology for Satellite, Space and Ultra-Weak Signal Applications
by Courtney B. Duncan, N5BF/6
- Analysis of Maximum Elevation Pass Profiles for the AO-51 Satellite
by Gould Smith, WA4SXM
- Design of Eagle Modules
by Dick Jansson, WD4FAB
- ARISS - Ten Years as a Team and Six Years in Space
by The ARISS Team
- An EZ Lindenblad Antenna for 2 meters
by Anthony Monteiro, AA2TX
- Amateur Radio and the Cubesat Community
by Brian Klofas, KF6ZEO

To Order: **Proceedings - 2006**
(8½" x 11", 284 pages)

Write, telephone or FAX:

AMSAT-NA

850 Sligo Ave. #600
Silver Spring, MD 20910, USA

Tel: 301-589-6062

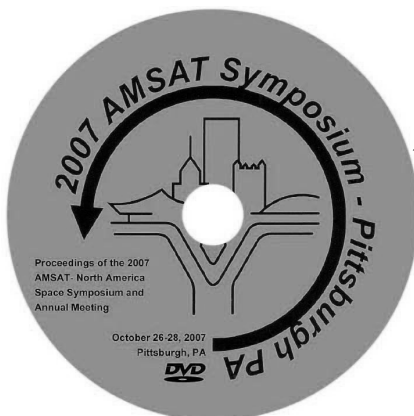
Fax: 301-608-3410

Minimum donation

\$20 in the U.S. + postage.
For rate to your mailing address see:
www.amsat.org and click on "AMSAT Store".
VISA, MasterCard or Discover charges are accepted.

Still Available!

Coming soon! Proceedings of the 2004, 2005 and 2007 Symposia all on one DVD including the 2007 Symposium PowerPoint presentations. Check the AMSAT Store for availability.



THE R.F. CONNECTION

*"Specialist in
R.F. Connectors and Coax"*
<http://www.therfc.com>

301/840-5477
Fax 301/869-3680
E mail: rfc@therfc.com

Order Line 800/783-2666
Suite 11, 213 N. Frederick Ave.
Gaithersburg, MD 20877



Experiments with Supercapacitors

John M. Franke, WA4WDL, jmfranke@cox.net (AMSAT #10211)

As with any area of science or technology, experiments in applying new technology to one area can benefit other areas. I have wanted to construct some compact RF test equipment for field use. I dislike having to keep stocks of fresh batteries for the instruments. The batteries seem to die at the worst times. And, NiCds have their own problems with memory effects, corrosive leaks, etc. So, I decided to investigate the use of small solar panels designed for garden lights in combination with supercapacitors to supply power when the panels are blocked by passing clouds and a dc-dc converter to generate the desired 5 volts at low power for the instruments. The results would be equivalent mAh ratings for the supercapacitors and converter combination. The situation is not that different from powering an orbiting satellite. In fact, several others have suggested using supercapacitors to replace the chemical storage batteries on Amateur Radio satellites. There is an excellent article in the November 15, 2007 issue of *Electronic Design* describing the use of supercapacitors in various applications including an AMSAT satellite (<http://electronicdesign.com/Articles/ArticleID/17465/17465.html>).

(Top or Component Side View)

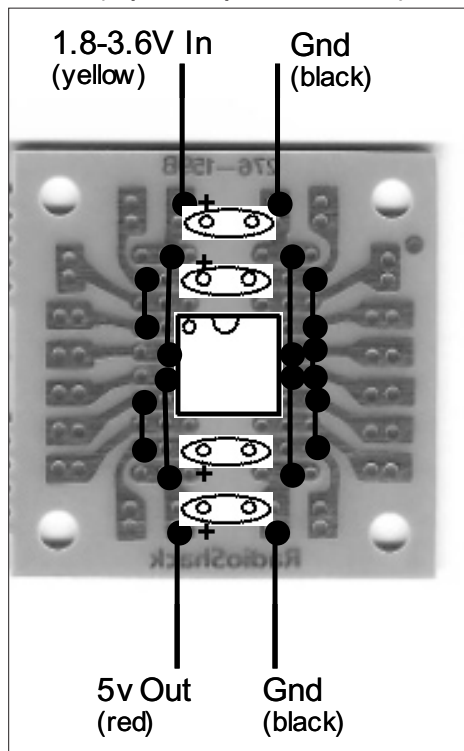


Figure 1a: MAXIM 619 breadboard, component side.

Reading about technology is great. Doing analytical modeling adds significantly to one's knowledge, but I firmly believe a little experimentation goes a long way in clarifying the ins and outs of the technology.

In addition to not having a memory effect, or defect, supercapacitors can undergo tens to hundreds of thousands of charge-discharge cycles versus hundreds for NiCd batteries. Supercapacitors do not suffer from overcharges or deep discharges.

One nice thing about solar panels is the inherent current limiting action. The area of the individual cells determines the maximum or short circuit current output. So selecting the area of the sub panel cells is like designing a built in current limiter, no integrated circuits or other components required. And remember, the supercapacitors cannot be overcharged. They will charge until the terminal voltage is equal to the open circuit voltage of the array, no higher.

The maximum output from the garden lamp solar arrays, which have eight individual series connected cells, is 3.6V. I planned to use several solar panels connected in parallel to charge one or two banks of supercapacitors connected in parallel to power a 20 mA load.

The amount of energy residing in a supercapacitor is simply $\frac{1}{2} CV^2$. Hence, to

know the charge state, merely measure the terminal voltage. The problem is in getting the energy out. One of the advantages of NiCd batteries is their ability to provide a constant output voltage throughout most of the discharge cycle. The output voltage of a supercapacitor exponentially decays as the energy is drained. Here is where the dc-dc converter comes in to play. I selected a MAXIM MAX619 switched capacitor charge pump converter with internal low drop out regulator. For input voltages from approximately 1.8V to 3.6V, the chip outputs a regulated 5 volts. Internally, the chip has a switched capacitor voltage doubler and tripler. For input voltages from 3.6V down to 3.0V, the doubler is used. For input voltages between 3.0V and the 1.8V shut off, the chip cycles back and forth between doubling and tripling. The switchover can be easily seen on the graphs by the break in the supercapacitor voltage line at 3V and the following increase in the discharge slope, which is indicative of an increase in discharge current.

To lay out the wiring diagram for the MAX619 dc-dc charge pump converter prototype circuit board, I scanned half of a Radio Shack 276-159 Dual General-Purpose IC Board, reversed the image, reduced the contrast, and made standard device drawings for 8, 14, and 16-pin integrated circuit

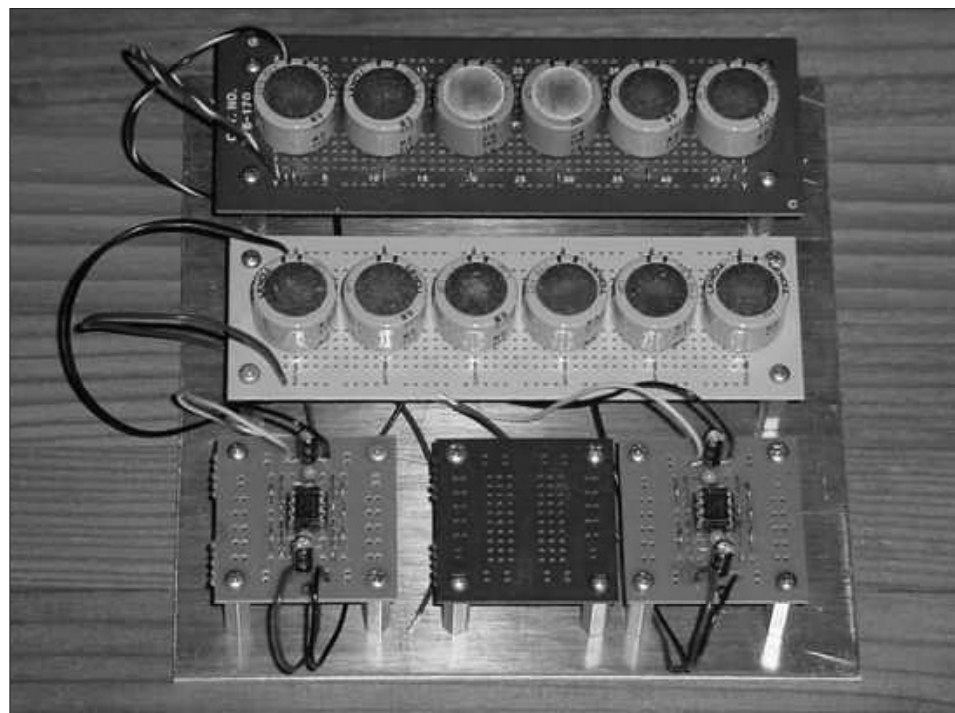


Figure 1b: Mechanical breadboard with two energy banks and inverters.

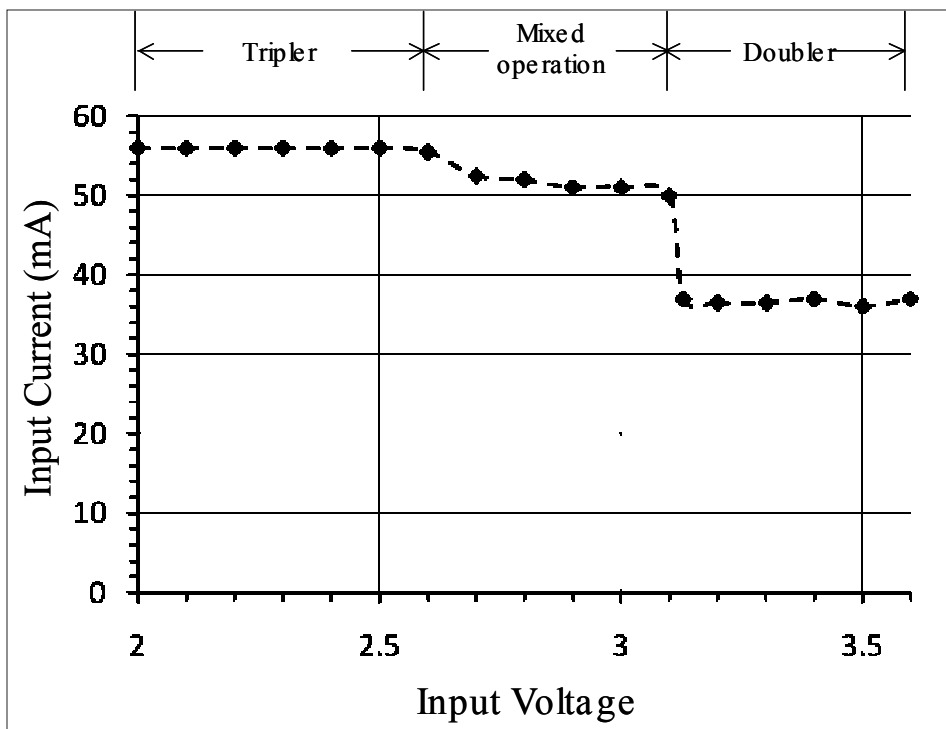


Figure 2a: MAXIM 619 input current as a function of input voltage for a 20mA load.

sockets, resistors and capacitors as depicted in Figure 1a. This way I can pick and place the drawings to lay out parts and jumpers real easy and have a permanent record of the circuit layout to facilitate making changes or duplicates.

I measured and plotted the input current verse the input voltage. I also plotted the conversion efficiency for each data point, see Figures 2a and 2b. It is easy to see when the

converter switched operation modes.

The next step was to design and fabricate the supercapacitor energy storage bank(s). I found I could fit six TOKIN FYD 5.5V 1.0 F supercapacitors on a Radio Shack 276-170 Experimenter-Printed Circuit prototyping board. The total capacitance per storage bank is a nominal 6.0F. I had to drill out the trace holes with a number 56 drill bit to match the relatively fat pins on

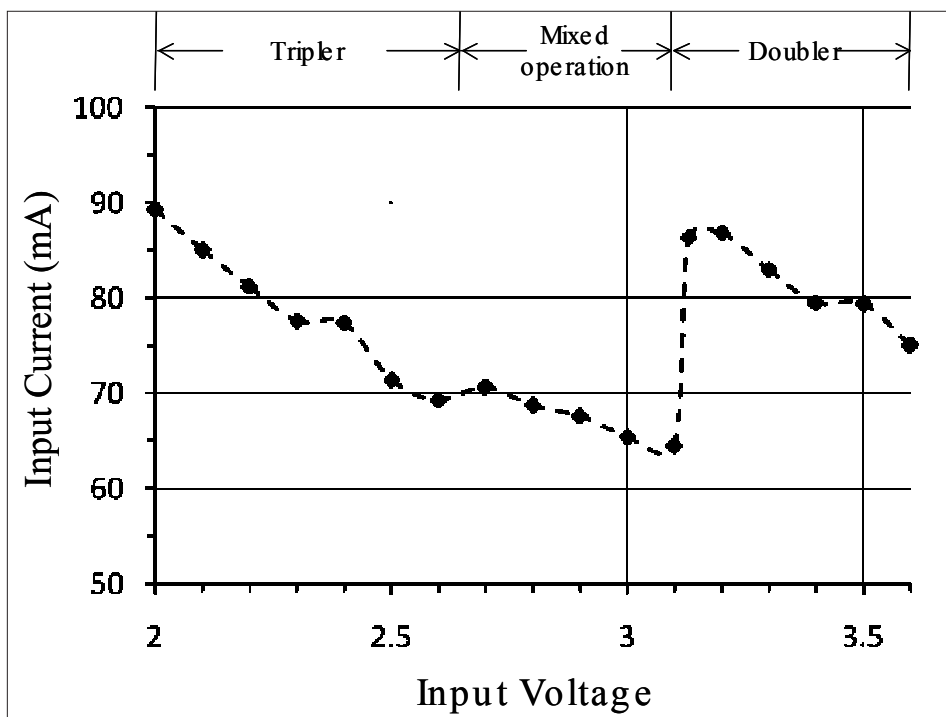


Figure 2b: MAXIM 619 input current as a function of input voltage for a 20mA load.

the supercapacitors. I made a test plate to hold two of the long prototyping boards and three of the smaller ones. The plate will be handy for future projects and helps to keep the boards from sliding around on my work bench. Two storage banks are shown along with two MAX619 charge pump converter circuit boards in Figure 1b.

I connected one MAX619 dc-dc converter to the 6.0 F supercapacitor storage bank. With a 6.0 farad energy storage bank and a 250 ohm load to the 5V output, the output voltage dropped to 4.95V after 2 minutes and 22 seconds for a total of 142 seconds. The MAX619 dc-dc converter begins to drop when the input voltage drops to 2.0V. Operation down to 1.8V is possible for lower output currents. To get a discharge time of ten minutes will require a capacitor bank of 27 farads. As expected, going to 12 farads did get me close to 4 minutes and 44 seconds. But, after making the quick tests, I wanted to see a plot of the entire data run.

My X-Y plotter does not have a time base, so I breadboarded a time base using a quartz oscillator driving a programmable divider string feeding a eight bit counter driving an eight bit D/A converter along with a pulser to make dots to keep the pen from wicking to the paper on the slowest speeds, a reset and run control, etc. So, fourteen integrated circuits and hundreds of wires on the breadboard, the time base driver works. I double checked the timebase using a quartz pocket watch. Heaven help me if a wire gets loose. Rather than hardwiring the design, I think I will purchase a PC oscilloscope later this year.

After a few false starts, I did run two plots. Three weeks of work to take twenty minutes of data. For both tests the supercapacitor bank(s) were charged to 3.6V. The plots have two curves: the MAX619 output voltage and the supercapacitor terminal voltage. The first plot, Figure 3a, shows the results using a 6F supercapacitor and a 250 ohm load. The second plot, Figure 3b, shows the results using a 12F supercapacitor with the same 250 ohm load. There are some interesting points on the plots, particularly when the MAX619 switches from a doubler to an alternating doubler/tripler. Figure 4 is a larger scale view of the plot in Figure 3a. Points of interest include the initial drop in supercapacitor terminal voltage due to the high ESR, the converter switching modes when the supercapacitor terminal voltage drops to 3.0 V resulting in a change in the

Figures 3a & 3b : Discharge cycles.

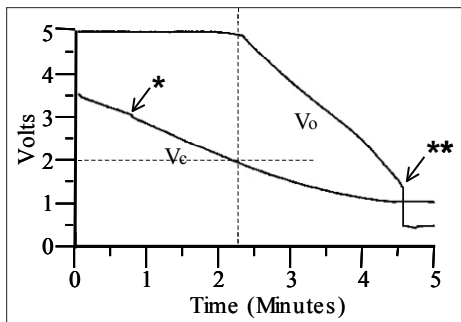


Figure 3a: 6.0 Farad, 250 ohm load.

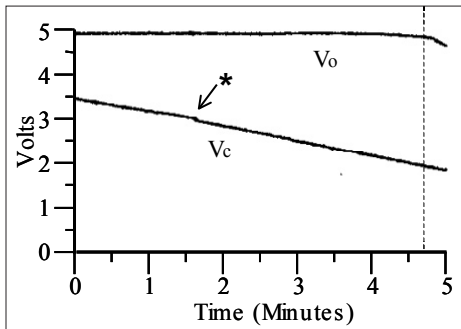


Figure 3b: 12.0 Farad, 250 ohm load.

* Transition point for dc-dc inverter.
** Inverter shut down.

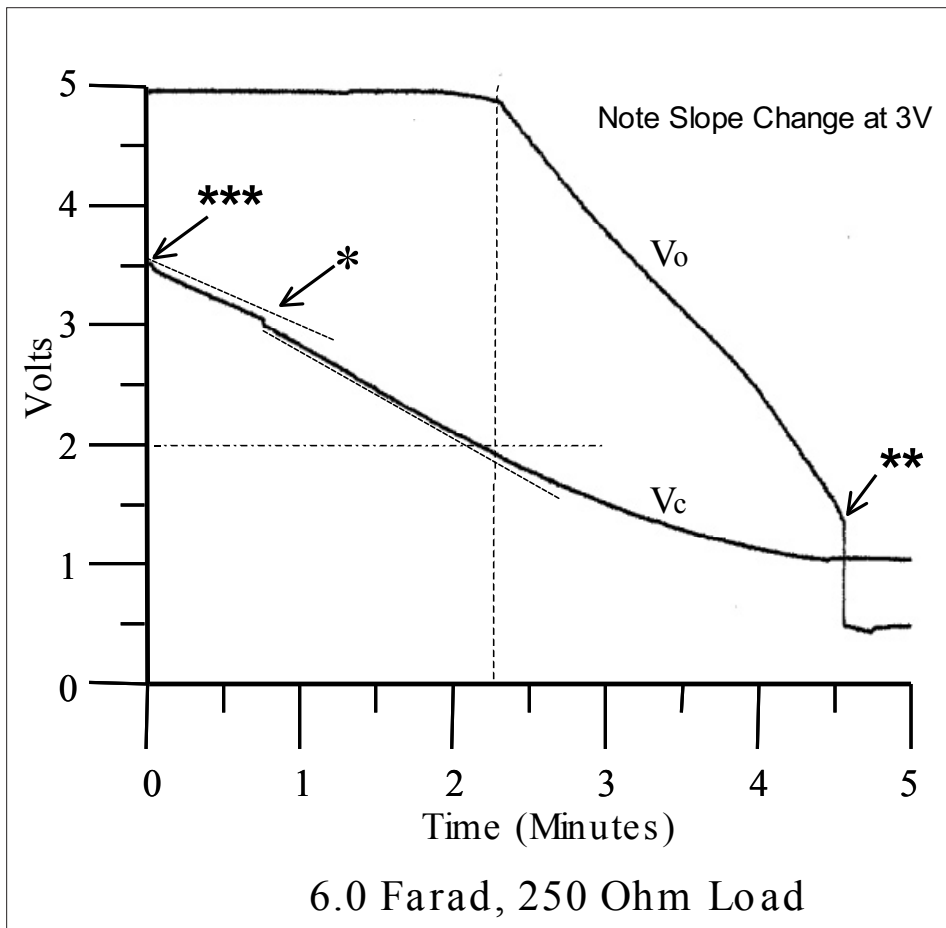
discharge rate, and the rapid drop in converter output voltage when the supercapacitor terminal voltage drops to 2.0V.

The system works for supercapacitor terminal voltages from 3.6V down to 2.0V. The per cent energy drain is $(V_{initial}^2 - V_{end}^2) / V_{initial}^2 = 69\%$ or 26.8J for a 6.0 Farad supercapacitor charged to 3.6V. Having a higher full charge voltage and/or a lower shut-off voltage would improve the numbers. Then there are the losses in the dc-dc converter, which has an average efficiency of approximately 75%. The delivered energy would be $26.8 \times 0.75 = 20.1J$. The actual output energy for 142 seconds is $(0.02A)(5V)(142 \text{ sec.}) = 14.2J$. The ESR (equivalent series resistance) of one 1.0 Farad supercapacitor is approximately 35 ohms at 1 kHz. Six paralleled supercapacitors would have an ESR of approximately 6 ohms. For an average supercapacitor delivered current of 55mA. The ESR losses would be $(0.055A^2)(6)(142 \text{ sec.}) = 2.6J$. Adding the ESR losses to the output energy, we get $2.6J + 14.2J = 16.8J$. The discrepancy is probably in the estimates of the ESR and average

supercapacitor current, and the actual values of the supercapacitor capacitance. The relatively high ESR also accounts for the initial drop in the supercapacitor output voltage when the load is first applied. There are more expensive supercapacitors available with ESR values below 0.5 ohms.

Results and Conclusions

Supercapacitors in conjunction with a switched capacitor converter/regulator do indeed mimic the operation of a NiCd storage battery. Configured as above, the 6.0 farad supercapacitor/dc-dc converter system can deliver $(20 \text{ mA}) \times (142 \text{ sec.}) = 2840 \text{ mAs}$. Or, a 1.0 farad supercapacitor can deliver 473 mAs. This might sound like a lot, but a typical AA NiCd battery can deliver 800-1100 mAh. Note the time scale difference. Changing to the same time scale, a 1.0 farad supercapacitor with charge pump converter provides $473/3600 = 0.13 \text{ mAh}$. Of course it would take four AA cells to get close to the 5V output from the supercapacitor system. To deliver the same energy as the four AA cells, one would need a supercapacitor bank with approximately 7700 farads. Even allowing for a system improvement of a factor of two, the number would be approximately 3800 farads. The volume of an AA battery is not far from the volume of a 1.0 farad supercapacitor. It does not take much imagination to realize how much bigger 3800 farads is than four AA cells! And, I do not believe much of a useful satellite payload can be powered from four AA cells. But, the door is open for other innovative concepts such as a microsat with a direct solar powered transponder and supercapacitor backup for just the controller and the command receiver. The satellite would not have the weight and reliability issues of any NiCd or other secondary batteries for the main payload. The transponder would only be active during sunlit portions of its orbit, and the supercapacitor would keep the computer alive and the command channel receiver awake during eclipses. ☺



* Transition point for dc-dc inverter
** Inverter Shut Down
*** ESR Drop

Figure 4: Detailed view of discharge cycle.

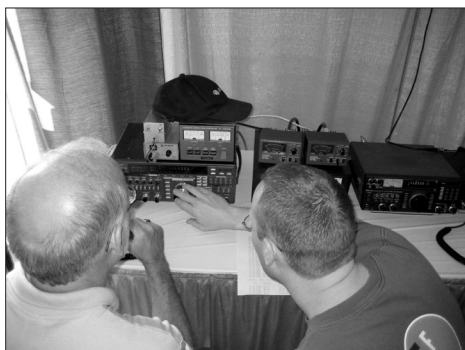


WA4SWJ



Recognize these guys? Part of the team at the AMSAT Orlando HamCation booth.

WA4SWJ



Dave Jordan, AA4KN, (l) demonstrates the fully functional satellite station at the booth to an unidentified ham.

WA4SWJ



The Lake Monroe Amateur Radio Society loaned this fantastic trailer equipped with a fully steerable antenna for use at the AMSAT booth.

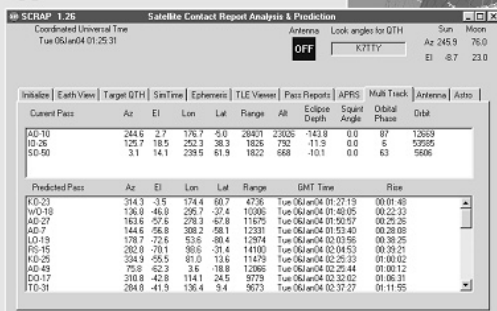
WA4SWJ



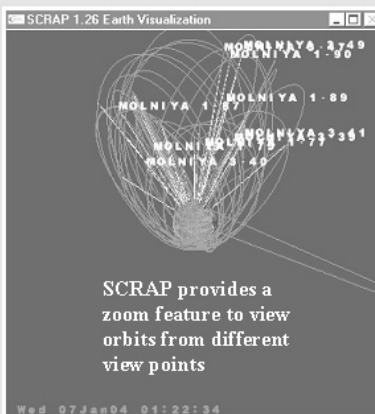
A large crowd turned out for the AMSAT forum.

Satellite Contact Report Analysis Prediction

AMSAT is now the North American distributor of SCRAP, a tracking program designed for ham satellite applications for Windows 95+



SCRAP provides a real-time contact report and display for over 2000 satellites on a Microsoft Windows 95+ Pentium platform.

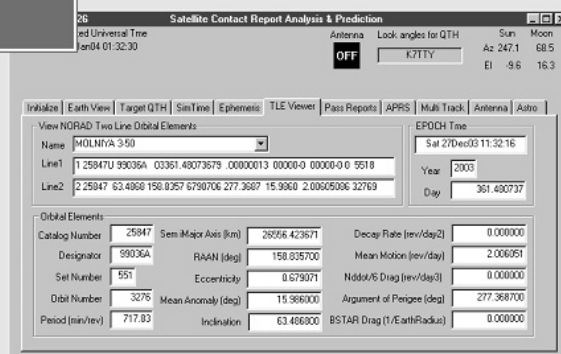


Eleven panels provide for controlling functionality

1. Initialization
2. Earth View
3. Target QTH
4. Simulation
5. Ephemeris
6. TLE Viewer
7. Pass Reports
8. APRS display
9. Multi-Track display
10. Antenna rotor control
11. Astronomical prediction

Performance Features

1. Contact Prediction / Reports
2. SGP/SDP ephemeris prediction
3. Real-time 3-D visualization
 - a. City, country, satellite labels
 - b. Lakes, rivers, islands
 - c. National boundaries
4. Over 20 map texture overlays
5. APRS station display
6. Multiple ground station support
7. Antenna rotor Az/El control
8. Internet updates
 - a. Two line orbital elements
 - b. APRS station locations
9. Astronomical data
10. Simulation



SCRAP

is a product of the

Bytheway Software Development Lab (BSDL)

Price is \$50 for AMSAT members, \$60 for non-members, postpaid on CD-ROM. Order by calling 1-888-322-6728, or use the online shop at

<http://www.amsat.org>

The author, Bill Bytheway, K7TTY donated SCRAP to AMSAT. All proceeds support AMSAT.

Free software upgrades and further information can be found at

<http://www.rtty.com/bytheway>



Minutes of the AMSAT Board of Directors Meeting October 5 and 6, 2006

[Editor's Note: These minutes are presented out of sequence with the last set published and are published mostly unedited in the informal style in which they were written. The last set of minutes presented in the last issue of *The AMSAT Journal* were from meetings that came after this one. Please refer to the last issue of the Journal for those minutes.]

The meeting started at 0820 PST in Yale Room at the Crowne Plaza Hotel, Foster City, CA.

All seven BOD Members present:

Barry Baines, WD4ASW
Tom Clark, K3IO
Emily Clarke, N1DID
Rick Hamby, W2GPS
Lou McFadin, W5DID
Bob McGwier, N4HY
Gunther Meisse, W8GSM
Lee McLamb, KU4OS (Alternate)

Guests present at the start of the Board Meeting:

Larry Brown, W7LB, Field Ops Area Coordinator
Bob Davis, KF4KSS, AMSAT Lab Manager
John Goettler, President-Goettler Associates
Perry Klein, W3PK VP-Government Liaison
Keith Pugh, W5IU, Director-Net Operations
Jim Sanford, WB4GCS, Eagle Project Manager
Martha Saragovitz, Office Manager
Paul Williamson, KB5MU, Director-Electronic Communications
Gould Smith, WA4SXM, Director-Field Operations

Welcome to new BOD members.

Rick noted that the Board is AMSAT's strategic entity. Its focus is on strategic issues.

Motion to reelect Richard Hamby, W2GPS, as President was seconded and approved unanimously.

Proposed Executive Team

- Executive VP: Lee McLamb, KU4OS
- VP-Operations: Drew Glasbrenner, KO4MA
- VP-Engineering: Bob McGwier, N4HY
- Marketing & User Services: TBD
- Corporate Secretary & VP Special Projects: Barry Baines, WD4ASW (Special Projects-includes Dayton)
- Treasurer: Gunther Meisse, W8GSM
- Manager: Martha Saragovitz

Motion to Remove VP-Human Spaceflight from senior officer position. Moved by Tom Clark, K3IO and seconded by Bob McGwier, N4HY. Approved unanimously.

Moved to have the Secretary to cast a unanimous ballot for slate of officers as presented. Motion by Tom Clark, K3IO, and seconded by Gunther

Meisse, W8GSM.

Approved by BOD with one opposed (N1DID).

President's Report - Rick Hamby, W2GPS

Started at 0841

AO-51

- Software upgrades are needed soon to keep satellite functioning well

- Engineering to manage upgrades

- Issue: We didn't have control of the software and engineering diagrams until three weeks ago. Harold Price has the only AMSAT IHU simulator.

- Issue: Power Management/Battery charging is the one area we can focus on. The current BCR software doesn't reflect current technology of AO-51 as it is based on Microsat configuration.

- In the coming year we will have an improved asset with the implementation of software an operational improvements.

Ground station: Threshold effect — increased satellite transmitter power (from .5 watts to possibly 3 watts) will help users receive the satellite downlink better.

Another question: We haven't tried flipping the spacecraft. We have never pulsed the magnet in space. The magnet polarity can be reversed, which will flip spacecraft. The original idea was to flip it once a year.

ARISS — Participating in an ARISS contact is a 'Life changing event.'

AMSAT could do more to support ARISS such as implementing a post follow-up curriculum for volunteers to use.

Marketing and User Services

- We need to focus on a unified AMSAT messages and outreach, including publicity.

Engineering

- New science and technology needs acceptance by users.

- P3E, Eagle, SuitSat2 all will have SDX. We need to inform the membership of the advantages of the new technology. We also need to recognize impact of words such as 'digital' that don't preclude voice and other traditional modes and we need to interpret the impacts to the user community.

Question: Do we start a search for an AMSAT attorney to replace or augment the use of Chris Imlay who is the ARRL counsel? Rick to contact various lawyers to gain advice (such as John Ackerman).

Treasurer's Report - Gunther Meisse, W8GSM

Motion to accept 2005 Audit (unanimously accepted).

Voted to renew with auditing company: Berlin,

Ramos & Company, PA (moved by Gunther Meisse, W8GSM and seconded by Emily Clarke, N1DID).

No issues from auditors — first time in years. Martha and the accountant have done a good job.

Database Committee established (AIMS)

Defined needs for single system for tracking donations

2004 produced first AMSAT Annual Report

Recertified by CFC — did \$6,000 in 2005 with 2006 campaign in progress

Q: United Way is not a national organization - must apply at local level

We need to publish United Way 'number' or explain how to donate with proper name

- Need to implement QuickBooks Pro for Non-Profits in 2007 at the office (1/1/07)

- North American Fund Drive Study to be presented by early 2007

- 2007 initial budget is presented. Operating Statement and balance sheet (cash, accounts, assets-including satellites plus liabilities). Proposed budget now has operating statement and balance sheet.

- Assume that National Fund Raising process doesn't impact 2007 Fund Raising

Manager's Report - Martha Saragovitz

Issue: Backup of data and applications of Martha's computer

The Board took break at 1008 PST. The meeting resumed at 1029 PST.

Executive Vice President's Report - Lee McLamb, KU4OS

Education - Small Sats. CubeSat conference: Kids are not too young for Space (KatySat) — an interactive satellite for students. DTMF uplink with voice response.

University NanoSat competition: NASA sponsored university competitions (50cm x 50cm x 60cm) — significantly sized satellites. Planning to use amateur frequencies. Educators are receptive to input if AMSAT sees them early enough in their project. University of Texas looked for AMSAT input. Universities are receptive to suggestions on experiments.

Lee would like to see a way for universities to communicate with each other. Can AMSAT provide a communications infrastructure or can provide mentors?

Government and Regulatory Issues

ITAR (will be discussed later)

FCC petition for consideration pending regarding orbital debris mitigation. Never 'implemented' and shows 'pending' but International Bureau is acting as if regulation has been implemented.



Went to the US Naval Academy (???) last week looking for a debris plan with no criteria for implementation and no penalty for failure to comply.

Rule is still pending with FCC. AMSAT filed Reconsideration, which means that we have legal standing in court in the event that future action is needed.

Question: Is there an AMSAT report regarding ex parte meeting? Perry Klein, W3PK, sent note on 7 May where AMSAT submitted to FCC a summary of the meeting.

Launch opportunities: Delta 4's and Atlas 5's typically have 1,000 lbs of excess capacity after primary payload, such as GPS. Lockheed Martin wants to become "ride share routine". Can go from contract to launch in 4 months. Can't wait for a launch to start putting effort into Eagle. There is competition for secondary payload opportunities. Key is to fit inside pre-engineered envelopes that have been developed.

Education

AMSAT-EDU list reactivated and not heavily used.

Controlled access-questionnaire for educators.

Orbital Classroom column in *The AMSAT Journal*

Presentations/conferences: Dayton, CubeSat conference, small sat conference

CubeSat mentoring

Budgeted travel funds to cover six different conferences to reach educational

- ham radio
- outside

Issue: Predecessor had a little 'O' VP title rather than a director position.

CubeSat frequency coordination discussed. AMSAT-International is looking at a new 'subband' for recommendation to IARU. During discussion, W5DID pushed for more active AMSAT role in CubeSat frequency coordination. FCC wanted AMSAT to take on regulatory role and AMSAT declined.

Two other external affairs issues:

1. AMSAT was invited to an ARRL BOD meeting and made a presentation. It is very unusual for outsiders to make such a presentation. The one hour AMSAT presentation was made 'in session'. The first 30 minutes was the official presentation with balance devoted to questions and answers.

- Issues raised: \$700k ARRL donation to P3-D

ARRL and AMSAT are prepared for better relations. Two issues were discussed with ARRL: The P3D failure explanation and the Crystal City ARRL/AMSAT minutes being released with confidential information.

2. DOD Meeting: AMSAT met with the DoD national space security organization, represented by Gen. Richard Armor, USAF and his staff. QDR planning includes cadre of organizations to help them develop new talent for engineering and science. DoD is looking for a good organization to fulfill this goal. AMSAT doesn't know what the 'quid pro quo' is yet. An MOU would be with DoD and will need to be reviewed by the AMSAT Board. The MOU would be signed with Dr. Rick Saga, a former shuttle astronaut and acting secretary of the Air Force. We want launches.

Human Space Flight

There is no direct NASA representation on ARISS. Frank Bauer is the AMSAT representative.

Observation: NASA is reducing their education budget while the DoD increases its education budget.

SuitSat-2 is a major enhancement over SuitSat-1

- 400bps beacon (same as AO-40)
- List of ham calls of supporters
- Crossband SSB transponder
- FM Beacon announcement (voice messages)
- More RF Power

There have been two SuitSat-2 meetings to date. A third meeting will be held here in SF next Sunday.

Broke for lunch at 1215 PST/ Reconvened at 1323 PST

Engineering Report - Bob McGwier, N4HY

Bob McGwier, N4HY, met with Hawke Institute for Space Science (Bob Davis). The proposal is to relocate the AMSAT Lab from Florida to Maryland with Bob Davis becoming the Lab Director. We will go for a final round of meetings with University of Maryland, Eastern Shore MD, local volunteers and others.

Mid-Atlantic Institute Science & Technology (MIST) owns the building we will occupy. MIST is a group of five states supporting high tech 'incubators'.

We will collocate the Lab with the Hawk Institute for Space Sciences (HISS), a division of the Maryland Hawk Corporation, which is a non-profit affiliated with the University of Maryland Eastern Shore. HISS is able to do commercial contracts (e.g. NASA Wallops Island) charging for profit rate. HISS will be doing 4 CubeSats with UMES.

Through HISS we hope to obtain access to the thermal vacuum chamber at NASA Wallops. There will be access to a machine shop at HISS and possibly at NASA. NASA Wallops is a facility under the management of NASA Goddard.

HISS has five full time employees, three on contract with no current hours. Bob Davis is the only ham on staff. Two other staff members are interested in volunteering for Eagle. They are currently doing engineering services for NASA.

AMSAT's clean room is about 20 ft x 20 ft, which would be installed at HISS. AMSAT would have first priority on clean room usage.

AMSAT needs to work out MOUs with HISS and UMES to establish a working relationship. Current concerns are whether 'they' can build a cadre.

Eagle Review

Jim's team met in June, reviewed the user services that are wanted and came up with a revised satellite design.

Meeting in Washington State to finish IHU-3.

AO-51 Review

Parametric characteristics need to be updated to reflect AO-51 configuration.

Need to keep AO-16 in mind when doing development work. With upgraded software AO-16 could see a new lease on life.

P3-E Report

An SDX is the primary transponder

AMSAT-NA is providing the command and control buss for P3-E w/IHU-3.

A goal is to finish the final software deliverable by end of Nov 2006.

The AMSAT-DL lab (ZEL) will close in June 2007 if they cannot afford to reimburse the university's rent of 40,000 euros. AMSAT-DL depleted their funds buying their triple junction solar cells and motor. There is a potential launch on a Soyuz vehicle from Korou into GTO in November 2008. There may be competition for this launch from the ESEO satellite (Howard Long and Graham Sherville).

If AMSAT-DL asks AMSAT-NA to integrate P3E, they will probably not have any money to pay for final integration. There is no activity on P5-A, but AMSAT-DL is spending money on the ground communications station.

Suitsat-2

Microchip is rolling out 16-bit DSP PICs with the ability to do operations in parallel.

Several different transponders and beacon.

SuitSat-2 will use the dsPIC33GJ256. We will take delivery of one of these new chips in two weeks.

Electronic Communications

UCSD provides AMSAT with a free site with support (backups and power) and provides a front end to handle incoming mail and spam filtering. There have been outages and performance issues due to our low priority.

Marketing & User Services - Barry Baines, WD4ASW

An overview of the Marketing & User Services was presented which provided updates on the status of ANS (AMSAT News Service), *The AMSAT Journal*, Web services, Electronic Communications and Fund Raising.

Key points:

AMSAT News Services

- Timely updates of news items is a concern
- News sources need to be increased
- Over the past year, the AMSAT Web site front page has had the ability to be 'managed'



by the ANS Editor

- Looking at how we can increase ANS visibility?
- New feeds?
- More updates on breaking stories?

The AMSAT Journal

- Essentially a one person operation - Ed Long, WA4SWJ. (*Two persons - also Bill Hook, W3QBC - Ed.*)
- The AMSAT Journal on CD ROM (2001-2005) is making 'slow' progress
- 'Features Editor' still needed
- Advertising is a concern

Awards

- Interest in Awards has increased since placement on the AMSAT Web site
- The 'AO-51 on 51' Award generated 70 submissions as of 12/05 when the award was closed
- 'Basic' Award(20 contacts) continues strong
- Field Day Winners announced in latest *The AMSAT Journal*
- New Awards are being considered

Web Store/Other Sources

- Since opening on 18 Nov 2004, the AMSAT Web Store has been an excellent revenue source
- Average usage has been steady:
3.8 submissions/day in 2004
3.0 submissions/day in 2005
3.3 submissions/day in 2006
- The Web store provides a convenient means to handle AMSAT transactions
- AMSAT has created eBay process to attract donations
- MissionFish has been incorporated into donation process
- Unfortunately, no donations have been made to date

Electronic Communications Services

- AMSAT continues to provide an extensive Electronic Communications Service Offering
- Mail Alias Service: approx. 14,200 aliases
- 48 Active Mailing Lists (public & private)
- 15 mailing lists archived in digest form plus amsat-bb and SAREX archived in Web form
- KEPS bulletins are automatically stored in Web site
- KEPS bulletins are automatically converted to PDB format
- ANS bulletins automatically stored and archived
- AMSAT Conference Room in Echolink used for ARISS contacts

- Houston AMSAT Net audio recording provided by KK5DO

HF Nets

- 20 Meter Net on Sundays 1800-2000 UTC (includes reading ANS Bulletins)
- 80 Meter Net no longer operational due to loss of Net Control Station, W3STW
- HF Net participation continues to be soft
- Perhaps 8 to 12 check-ins per net per week
- Provides an opportunity for stations to ask questions, speak with AMSAT officers
- Impacted by band conditions
- AMSAT officers are encouraged to check-in

Houston AMSAT net is available on the Web and on Satellite

Local VHF nets continue in various parts of the US

- Central Florida Net Established in 2006
- Listing needs to be updated

Fund Raising

- Deanne Lutz, K7DID, has done a masterful job of developing support materials
- AMSAT's first major appeal letter, released in December 2005, was well received
- Updated brochure was made available at Dayton
- A major appeal letter needs to be sent out before December 2006

We are a 'victim' of our own success

An appeal letter to the membership needs to clearly define the characteristics of the 'refined' Eagle

A key goal is to translate the 'Vision' into 'Something Tangible' that will excite our members and assures them that Eagle is REAL and managed well.

- President's Club continues as a fundraising venue
- Combined Federal Campaign

In 2007, multiple appeal letters need to be sent, each focusing on a different aspect of AMSAT's Mission/Vision

ARISS

Education

Eagle

Other?

Need to coordinate with the North America Fund Raising Initiative

Field Operations - Gould Smith, WA4SXM

Dayton Update:

\$28,159 in 2006
\$21,866 in 2005
\$20,098 in 2004
\$16,699 in 2003

Significant increase in 2006 of Dayton memberships

Renewal/New Members

188 38 in 2006
158 44 in 2005
143 34 in 2004
177 46 in 2003

Eagle area in the AMSAT booth worked well.

AMSAT will keep the outdoor area for satellite demos

We are projecting less Forum Time next year - perhaps over 3 days rather than one session.

Joint AMSAT/TAPR Banquet at the Air Force Museum:

- Shooting for 250 attendees
- Usage fee approx \$1400 split with TAPR
- Possible Jazz band
- Either will have a Speaker or use time for attendees to look at aircraft

Break at 1630

VP-Operations report - Drew Glasbrenner, KO4MA

AO-7 (issue of control - can we turn it off?)

AO-16 (memory mapping)

- need to map new bad spots
- need to develop memory bypass of bad spots
- Digipeat retasking (sound card vice modems)

AO-51

- Long duration WOD in August
- Conclusions sent to BoD — The BCR is overcharging when transmitter is on high power
- At 1.8 watts transmit output command capability is locked out. We are not sure if the problem is in the radio or the computer.
- The software needs work. Only one receiver can be used (out of 4). The SQRX is used for digital uplink. We could improve performance by using another receiver.

- AO51 left hand circular downlink makes it tough for digital downlink at .3 watts.

- SQRX draws 135 ma at 5vdc (800mw). Command receivers use 1/10 of that.

- Colin's empirical testing shows that the S-Band transmitter with 500ma is good.

- Bump output and the uplink becomes more difficult.

- With 1.5 watt output, telemetry becomes a problem. Could be a sensor issue.

Gould, WA4SXM is backup command station to Mike Kingery.

Vision/Mission: Quick review of statement.

ITAR Discussion - Led by Rick Hambly, W2GPS

ITAR: International Traffic in Arms Regulation

Covers:

- Spacecraft and ground control stations
- Technical data and defense services, including detailed design, development,



manufacturing or production data for all spacecraft and specifically designed or modified components for all spacecraft systems.

- This includes all technical data, without exception, for all launch support activities (e.g. Technical data provided to the launch provider on form, fit, mass, electrical, mechanical, dynamic, environmental, telemetry, etc.)

Rick and Bob met with Miller & Cheavallier
13 Sep 06

Next Steps:

- Registration (we were registered before)
- Technical Assistance Agreement (TAA) with AMSAT-DL and AMSAT-UK
- Licenses: DSP-5 (permanent export) and DSP-61 (temporary import)

Training needed for AMSAT volunteers on ITAR. Raytheon and Lockheed Martin are potential sources of training materials.

Eagle Report - Jim Sanford, WB4GCS Accomplishments for 2006

- UHF receiver design and peer review
- S-Band Amplifier
- SDX progress and demonstration at Dayton
- Advanced Communications Package (ACP) Design decisions
- Structure decisions
- Preliminary Power Budget
- Eaglepedia

Eagle team is using it
Members are reading it

Purchases

- SAW Filters for U Rx
- IHU-3 FPGA's
- Solar Cell samples
- SDX FPGAs
- SDX Demo boards

Meetings

- Discrete groups
- TeamSpeak

Spreading the Word

- Surrey
- Dayton
- Maryland State ARRL Convention
- New England Microwave Society
- Southeast VHF Society
- Central States VHF Society
- Various local hamfests

Plans for remainder of 2006

- Update U-Rx design from Peer Review
- Obtain and test SAW Filters

- SDX demos on the air
- Draft and Peer Review L-Band Receiver design
- Peer Review 2 m amplifier design
- IHU-3 meeting/workshop
- Project Charter
- Update FRD
- Plans/Schedule

Plans for 2007 and budget

- Prototype SDX
- Re-spin IHU-3 board
- Prototype and test antennas
- Spaceframe Engineering Model
- Power system components
- Refine ACP(Advanced Communications Package) design/protocols
- Develop ACP ground segment
- Sensor Team
- Several design team meetings
- Overall design review (?)

It is time to make the concrete decisions and build schedule and plan

\$192,000 planned expenditure in 2007

Payload Decisions

Services to be provided, as defined at the San Diego meeting:

- Class 0 is linear transponder users
- Class 1 is SMS text messaging service
- Class 2 is weak signal voice grade digital channel
- Class 3 is strong signal, large antenna, higher bandwidth signal (think compressed full motion video)

Primary Class 0 payload

- U/V with a design goal that it be useable over 75% of the orbit

Primary Class 1 payload

- U/V for the reasons discussed at San Diego

Primary Class 2 and 3 ACP Payload

S2/C useable over 75% of the orbit

Electronically de-spun phased arrays on S2 and C

At San Diego, we discussed S2 vs. S1 and S2 was technically superior

Other issues caused us to shy away from S1

Upon reflection, decided to use technically superior path, S2 uplink

No performance level is to be promised

Payload Decisions

Secondary Class 0 payload (not available at all times of the year)

L/S1 if and when power budget and fixed, nadir-pointing antenna can support

May not be usable in many areas due to elevated S1 noise floor

Discussed in San Diego and documented in measurements

and analysis

Secondary ACP Class 2 uplink

A separate L-Band receiver feeding same DSP and C-band downlink if and when power budget and fixed, nadir-pointing antenna can support.

Share the L-band LNA

Payload decisions

We need the Board of Directors to ratify the transponder payloads so that we can begin the job of really selling Eagle

Motion to accept the recommendation of the Eagle Design Team regarding Band Plan and Services for Eagle:

Payload decisions

1. Services to be provided:

Class 0 is linear transponder users

Class 1 is SMS text message service users

Class 2 is weak signal voice grade digital channel

Class 3 is strong signal, large antenna, higher bandwidth signal (think compressed full motion video)

2. Class 0 payload:U/V with a design goal that it be usable over 75% of the orbit.

3. Class 1 payload:U/V with a design goal that it be usable over 75% of the orbit.

4. Class 2 and 3 ACP payload:S2/C useable over 75% of the orbit. (Electrically de-spun antennas.)

5. Class 0 payload:L/S1 - if and when the power budget can support. (Fixed, nadir-pointing antennas.)

6. Secondary ACP Class 2 uplink: A separate L receiver feeding same DSP and C-band downlink when fixed nadir-pointing antenna array supports.

Motion made by Gunther Meisse, W8GSM, and seconded by Barry Baines, WD4ASW. Question called by Gunther Meisse.

Board Vote:7-0 approving the motion.

Recessed starting at 2045 PST

Meeting reconvened at 2107 PST

2007 Budget Review - Led by Gunther Meisse, W8GSM

Meeting adjourned at 2156 PST

The AMSAT Board of Directors Meeting was re-convened on Friday, 6 Oct in **Closed Session** at 0815. All present with exception of Emily Clarke, N1DID. Alternates also present.

Rick Hambly, W2GPS

Tom Clark, K3IO

Lee McLamb, KU4OS (alt)

Bob McGwier, N4HY

Barry Baines, WD4ASW

Paul Shuch, N6TX(alt)

Lou McFadin, K5DID



Gunther Meisse, W8GSM

Emily Clarke, N1DID arrived at meeting at 0825

Subjects covered during closed session:

Manager's Evaluation and Compensation

National Fund Raising

Future applications of SuitSat technology

Closed session ended at 1010 PST with a recess.

Open Session started at 1032 PST

Budget - Gunther Meisse

Deficit from Operations is \$66k. "Specific fund raising efforts" is currently blank. It is a bad idea to start spending reserves to cover deficit. We need one year's worth of investment cushion. However, we could use reserves to provide temporary cash shortage.

1,850 annual renewing members.

Gunther's Proposal: 'Assess' each member \$100 for Eagle. Modified proposal:

1. Each quarter produce a 'one sheet' "Eagle Construction Progress Report" to be sent to every member of AMSAT, plus each additional contributor.

2. Make the assessment voluntary.

Gunther's motion \$250,000 Eagle construction budget for 2007 seconded by Rick

Board approved 7-0.

Proposal: We implement a volunteer assessment - "Sense of the Board" 7-0 supports.

Suggestion: We have a satellite operating award based upon AMSAT member number. Work with KK5DO to institute program. Drew, KO4MA noted that less than half of users of VUSAT are AMSAT members.

Motion to adopt budget with \$250,000 listed under 'Specific Fund Raising Projects'. Seconded by Rick. Board voted to adopt budget: 7-0.

2007 Annual Meeting Proposal

See proposal on <http://n3sh.org>

Jim Sanford, WB4GCS, presented a proposal at Pittsburgh, PA on behalf of Kevin Smith, N3HKQ.

A second proposal to hold the annual meeting in Orlando, FL was presented by Lou McFadin, W5DID, on behalf of Cindy Radish, K4NLV, and Dave Jordan, AA4KN.

After presentations were made followed by Q&A plus discussion, the board voted to accept the Pittsburgh proposal. Board votes: 5 select Pittsburgh (Clark, Clarke, Hambly, McGwier, Baines)

The Board thinks that having the Symposium in Orlando 2008 and Atlanta in 2009 is a possibility.

ATTA Boys

Award recipients are listed.

- Martha, Bob Carpenter and Bill Hook did not want awards

- Gould Smith: Ed Collins for Dayton Hamvention

- Tom Clark: Bob Davis technical details, Eagle, UMDES

- Tom Clark: AMSAT-UK:Satellite program in support of SSETI and other projects

- Rick Hambly: Fund Raising Auction in UK-Jim Heck

- Tom Clark: Non-amateur — John Goettler of Goettler Associates

- Tom Clark: Eagle Team who helped us get ready for San Diego: Franklin Antonio, Kathy Schultz, Phil Karn of Qualcomm for helping to arrange one of our most successful meetings (corporate board room of Qualcomm)

- Tom Clark: \$17,000 grant from HP (projectors, laptops, desktops). Tom Clark made the submission. AMSAT was one of 100 selected out of 2000 applications submitted. AMSAT was one of two technical organizations who were granted equipment.

- Lou McFadin: Getting ready to ship HF radios to ISS. Will send up to FT-817 QRP rig, replacing the FT-100. Chip Margelli and his wife have agreed to pay for the FT-817.

- Bob McGwier: Matt Ettus and his efforts on behalf of Eagle, along with John Stephenson. 'MVP caliber' contributions.

- Lou McFadin: Steve Bible and Microchip (Joe Julisher) provided SuitSat-1 board on short order.

- Emily Clarke: Jean Fletcher, Symposium Proceedings Editor did a great job of getting Proceedings published. Cost less to print than in past.

- Tom Clark: Cliff Buttschardt, K7RR — former Area Coordinator, CubeSat mentor, is remembered.

- Fax from Harry Yoneda, JA1JNG, giving best wishes.

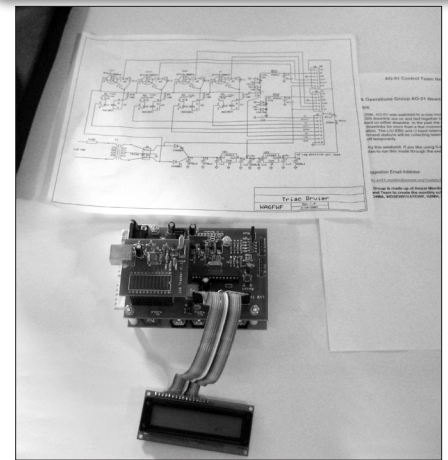
Tom Clark: On behalf of technical team - Rick Hambly learned to beg software vendors to get education rate on crucial software. Cadence OrCad, Mentor Graphics (2 packages) FPGA Suite of Programs, PADS PC Board layout.

Meeting adjournment proposed by Tom Clark seconded by Bob McGwier.

Meeting adjourned 1222 PST.

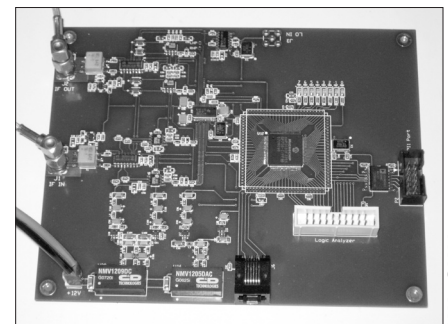
Respectfully submitted,

Barry A. Baines, WD4ASW
Corporate Secretary



WA4SWJ

LVB Tracker with USB board and a new power board designed by WA6FWF that eliminates the need for the rotor control box.



WA4SWJ

SDX circuit board planned for SuitSat2. The dsPIC is the large QFP package just to the right of center on the board.



WA4SWJ

Dave (l) and Drew (r) caught in a rare lull in the action. The AMSAT booth did very well with a significant increase in sales over last year's efforts. Thanks guys!



WA4SWJ

The seldom seen AMSAT Journal Editor Ed Long, WA4SWJ.



Been thinking about working some birds?



Icom 910H **The perfect satellite rig**

Now that summer's on the way out, it's the perfect time to think about getting back to the shack and trying something way out. Work the amateur satellites - the OSCARs!

In 1961* the first amateur satellite, OSCAR 1, orbited Earth for nearly a week, putting ham radio right in step with the space age! In recent years, AMSAT® has launched some exciting amateur "birds" for the use of amateurs worldwide. The IC-910H is the perfect radio for satellite operation through new satellites such as ECHO, AO-51, and VUSat, AO-52!

OSCAR	Mode	Frequencies
AO-51	FM/PacSat	10m**/2m/70cm/23cm/12cm
AO-52	Linear (CW/SSB)	70cm/2m

Visit your Icom dealer today!

Free literature: 425.450.6088

or www.icomamerica.com

AMATEUR | AVIONIC | LAND | MOBILE | MARINE | RECEIVER | SYSTEM

ICOM®